DISCOVERY

A Monthly Popular Journal of Knowledge

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WINGED IBEX FROM PERSIA

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Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Professor A. C. Seward, Sc.D., F.R.S., Professor R. S. Conway, Litt.D., F.B.A.

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Notes of the Month.

Three subjects much in the public eye are dealt with in this issue. Sir Martin Conway discusses the problems of climbing Kanchenjunga, the highest peak in the Himalayas, on which a new attempt will be made next summer. In another article Mr. C. J. Gadd describes the discoveries at Ras Shamra which throw important light on the age of the alphabet. Thirdly, some aspects of Persian art are discussed by Mr. Stanley Casson. We are sometimes criticized for covering such widely different subjects in *Discovery*, it being suggested that we fall between several stools in the process. There are grounds, no doubt, for this view, but a little reflection will show that problems still remain to be solved in every branch of knowledge. The challenge is the same, whether the subject involves a physical battle with nature or is a matter for secluded study and research. The fundamental appeal of these problems—in mountaineering and art alike—is shown by their association with several countries. The new expedition to Kanchenjunga will be made by Bavarians, while climbing in other parts of the Himalayas is being planned by English mountaineers. The excavation of Ras Shamra is in the hands of the French, who owe much to the co-operation of English colleagues in interpreting their new discoveries. The international character of science is, indeed, its most striking feature. Politicians may continue to think in terms of frontiers, but scholars are not so hindered.

* * * * *

The latest example is afforded by the Persian Art Exhibition, for which exhibits have been brought to London from thirty countries. Following the joint lead given by the King and the Shah of Persia, the enterprise was officially supported by societies devoted to Eastern Art in France, Germany and the United States. A tour of over 30,000 miles in all parts of the world was made by the organizers. The generous response of public and private owners has been worthy of the magnanimity of the Persian government, which not only opened its secret treasuries but permitted objects of the most sacred character to be removed for the first time from Persia. When Lord Curzon visited the country he was not even allowed to enter the Royal Library, so strong is the tradition relating to the privacy of the Shah. Several attractive books have been published about the Exhibition, but one aspect of Persian art has so far received rather scant attention, namely, the art of the Achaemenidae. We therefore invited Mr. Stanley Casson to write on this subject, and his article forms an important addition to the available literature.

* * * * *

Naturally, a good deal of interest is attracted by the "invisible ray" which protects the Shah's jewels from burglary. The device was described in *Discovery* two years ago, when it was first applied to railway signals. A beam of infra-red rays is directed on to a radio-visor bridge, and if any object intercepts the beam, the circuit is broken and an alarm is sounded. At the Persian Exhibition the apparatus is concealed in two ornamental pillars, and we observed a good deal of amusement when it was demonstrated to some of the visitors at the Private View.

* * * * *

The new Bill to amend the Acts for the Protection of Ancient Monuments proposes extended powers for the Commissioners of Works. At present they are confined to issuing an order which protects the monument itself, and reserves only so much ground as is required for access and for fencing the monument. It is now proposed to prohibit all excavation, quarrying, felling of trees and building, where such development would be detrimental to the amenities of a monument. The dangers which threatened

Stonehenge until the adjacent land was purchased after a public appeal for funds, and the possible quarrying near the Roman Wall, are two instances which show the need for strong measures. Powers are also proposed to prohibit the export of ancient monuments. No doubt this is a valuable safeguard, but a too rigid interpretation might cause hardship to private owners. There are many cases where a sale to America has restored the family fortunes, and it would not be easy to discriminate between one form of property and another.

* * * * *

A neolithic village, considered to be one of the most complete yet discovered in England, has been found at Playden in Sussex. The find was made in plough-land, where scores of arrow-heads were brought to light with other flint implements and fragments of pottery. If further investigation confirms the character of the discovery it will provide important evidence on the New Stone Age in Britain. Fragments of oak believed to be the remains of a pit dwelling would support the inference that this is a settlement site. Even more interesting are some human remains found at the bottom of a circular pit twelve feet in diameter, probably the excavation of a pit dwelling. Sir Arthur Keith suggests that they are the bones of an elderly woman, about five feet in height. It is a practice among some primitive peoples to bury the dead in the dwelling occupied during their lifetime. The new find may be an instance of a similar practice, in which case it throws interesting light on early burial customs in this country.

* * * * *

In a recent article Dr. Mortimer Wheeler described a prehistoric earthwork near the Romano-British city at St. Albans which may possibly be the site of the earlier British settlement. Investigations in two different areas have resulted in similar discoveries. The National Museum of Wales, in excavating a hill-site two miles from Caerwent, the Romano-British city of Venta Silurum, has found a fortified enclosure situated on the southern slope of the ridge which constitutes the northern boundary of the Monmouthshire coastal plain. The foundation of the enclosure is dated at not earlier than 200 B.C., and it continued in occupation down to the Roman period when its place was taken by Venta Silurum. The second discovery is at Letchworth, Hertfordshire, where a Romano-British settlement has been found associated with relics of the Bronze Age and the early Iron Age down to 200 B.C. In the earlier days of excavation on Roman sites in Britain, such relics were apt to be overlooked or ignored, with the result that the gaps in our knowledge of the obscure period preceding the Roman conquest are only now being slowly completed.

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The installation of new heating apparatus in the nave of Westminster Abbey has revealed the original foundations of the Norman Abbey Church. This discovery is likely to lead at last to a solution of the problems which have long baffled students of the Church of Edward the Confessor. Systematic cleaning in the south transept has brought to light another interesting feature, for it is now possible to examine the censing angels in the spandrels under the rose window. According to *The Times*, it is clear that the angels were once brightly coloured. Traces of colour appear in the wings and in the folds of their garments, and the drapery has been patterned with stars and crosses. Professor Letharby suggests that they may with confidence be attributed to Master John of St. Albans, sculptor of the king's images. He also asserts that the slightly later angels in the " Angel Choir " at Lincoln are so akin in feeling to those at Westminster that they, too, may be the work of this famous artist.

* * * * *

When chlorine was first introduced for bleaching purposes, it was little thought that it would be used a century later as a poison gas. Scarcely any scientific research has been conducted with the deliberate purpose of producing destructive instruments, and whether a discovery is used for good or evil depends upon the community. A strong plea was recently made by Sir Richard Gregory, who stressed the need for a new attitude towards science on the part of those who regard it as " a destroying angel or a maker of grimy social surroundings." Science, he said, poured its riches into the lap of man, but it could not be held responsible for their use. Chemists can provide explosives when a nation asks for them, but the greater part of their work has other intentions. It is not generally remembered that the proportion of lives saved by the use of antiseptics is far greater than those which have been sacrificed in war.

* * * * *

This month will see the inauguration of the African air mail service. Aviation is becoming so commonplace that we are inclined to overlook our debt to the pioneers who have been so busily, and unobtrusively, preparing the ground for these long distance routes. Preparations entail almost as much hard work, and certainly as much danger, as the pioneer work for earlier forms of transport. Air-Commodore Samson's new book on a flight from Cairo to the Cape is reviewed on another page.

The Attack on Kanchenjunga.

By Sir Martin Conway.

A new attempt will be made this summer to reach the summit of Kanchenjunga (28,000 ft.), the leader of the 1929 expedition which attained a height of 24,000 ft. being again in charge. The problems of climbing in the Himalayas are discussed by Sir Martin Conway, who nearly forty years ago himself climbed a peak 23,000 ft. high in this famous range. The photographs are the copyright of Professor E. J. Garwood, F.R.S.

THE eighteen eighties, I suppose, may now be considered as belonging to the "old days" of Alpine climbing. The great days were, no doubt, the sixties, when the Matterhorn and most of the other prominent peaks were climbed; but there still remained here and there some peak of unusual apparent inaccessibility, such as the Aiguille du Don and other aiguilles, which only fell after repeated assaults. By the eighties practically all were conquered. The Alps, from the point of view of men ambitious of novelties, were "climbed out." Thus the desire arose to venture further afield and attack the peaks of other mountain ranges.

Mr. Douglas Freshfield's party were, I believe, the first to investigate the climber's opportunities in the Caucasus. Their first efforts were crowned with remarkable success. They reached the summits of Elbruz and Kasbek. They brought back accounts of the existence and nature of other notable mountains in the range. In fact they opened the way which others presently followed. One after another all the great Caucasian peaks were climbed, and the names of Ushba, Koshtantau, and the rest became almost as familiar to English mountaineers as those of the High Alps.

From the Caucasus to the Himalayas was a natural forward step. The first climber to visit them was Mr. Graham, but his expedition may best be described as a raid rather than a serious onslaught. He climbed high on Kabru but did not reach the summit; moreover, unfortunately, he was not equipped either with the knowledge or with the instruments that would have enabled him to describe with accuracy the route he followed or the ascents he made or attempted.

Early Exploration.

It was not till 1892 that a serious and properly equipped expedition set forth from England to discover what in fact the great mountains of Asia are like, whether they or any of them could be climbed, what was their character, and what the nature of the garments of ice and snow by which they were covered. Of this expedition I was the leader, and my second in command was the Hon. C. G. Bruce, at that time a subaltern in the Vth Gurkhas, and since world-famous as Brigadier-General Bruce of Mount Everest.

Our ignorance of the region we were setting forth to explore was colossal. We envisaged the Himalayas as a long single range, stretching from somewhere north of Calcutta at the east end to somewhere near Gilgit at the west—a distance roughly speaking of over a thousand miles. Where should we tackle it? At one end was the Mount Everest group, with Kanchenjunga relatively adjacent; at the other was the scarcely less lofty K.2 and its associated peaks. These were not in fact on the same great ridge as Everest but on one situated further north, called the Karakorams. For our purposes one of them was as good as the other. The deciding factor was the probability of reasonably good weather in the climbing season. Beyond all question the K.2 end enjoyed the better climate, and we decided in favour of it.

A Sketch Survey.

I am not now concerned to describe our adventures. Suffice it to say that we covered a large area of previously unexplored mountains and glaciers and brought home a sketch survey of several hundred square miles. Other expeditions have in later years carried forward the work we began, notably those of H.R.H. the Duke of the Abbruzi and H.R.H. the Duke of Spoleto. Exploration once set on foot was not allowed to drop. Dr. Longstaff and his friends climbed in the mountains of Kumaon and he also investigated the great glaciers east of K.2 and of the region we had mapped, but the Everest-Kanchenjunga group was left severely alone till the Everest expeditions were organized and sent forth.

It must not be supposed that all this time longing eyes were not turning upon the eastern giants. Kanchenjunga is gloriously visible from Darjeeling, a view renowned as one of the most splendid in the world. Everest is visible from Tiger Hill, not far away. No mountains could be better advertised by their position than these. They were, however, politically inaccessible. Everest lies between Tibet

and Nepal—countries into which no European was allowed to travel. Kanchenjunga likewise presents three quarters of its faces to those same territories and only one quarter to British controlled Sikkim, but that quarter was clearly unclimbable. It was not till the political impediments were overcome that Everest could be attempted, and the three successive expeditions were sent forth whose doings are honourably enrolled on the scroll of great adventure. Everest was approached from Tibet in the north. The Nepal side was the best for attempting Kanchenjunga. When permission was given by the Nepal authorities it became possible to attack the mountain with what seemed like a possibility of success.

New Problems.

Those of us who first attempted to climb Himalayan peaks expected to find them a larger sort of Alps. There were practically no photographs in existence to prepare us for what we should have to face or to suggest that any entirely new set of conditions would have to be overcome. When we had been a few weeks at the foot of the great peaks our point of view entirely changed. We were up against problems for which the Alps offered no precedents. It was all very well to look at Kanchenjunga from Darjeeling or Everest from Tiger Hill and to prospect through a telescope for possible lines of ascent, but our eyes were accustomed to the scale of the Alps and it was not till we had actually come into immediate proximity with such giants that we were in the least able to realize their unwonted dimensions.

That, however, was not the most disturbing shock. It was natural to assume that among the great number of peaks of 24,000 feet and upwards which were known to exist in the Himalayan and associated ranges, a fair number would be *prima facie* climbable. What was our disgust to find that of all we saw the summit of none seemed attainable to men without wings. There was no opportunity of choice; what we had to do was to hunt for some exceptional peak that offered any chance of success. Most of them could not even be closely approached.

The reason for this inaccessibility is to be found in the fact that these ranges are, reckoned in geological time, of very recent elevation. Let anyone take a piece of laminated puff paste, break it in half, and turn the broken ends upward; that is the kind of thing that happened to the once horizontally bedded Himalayan rocks. They are broken, jagged, and precipitous as though recently gripped by cosmic forces, violently cracked and up-ended. That, at least, is how they look. But so soon as by movement of the earth's crust any portion of the surface rises above the normal level the forces of nature conspire to pull it down. Denudation is the enemy of elevation. If elevation goes ahead faster than denudation, the land surface rises, and if the process is continued long enough ranges of mountains are formed. They are, however, subject to decay even as they are being formed. The higher the mountain so much more vigorous is the destructive force that is destined ultimately to pull it down. Whether, as the balance between elevation and denudation, the Himalayas are still rising, or whether they have attained their maximum of elevation and are being reduced in altitude no one can say. What is obvious is that they are now being denuded at a tremendous pace, and this denudation presents a whole set of problems to those who would make ascents in the highest regions. The Alps are in no such dramatic stage of decay as the Himalayas. They have been pulled down and sculptured into rounder and for the most part far less jagged forms. Such aiguilles as those of Chamonix are rare and not very big. The ridges that look down upon the Baltoro glacier are set with teeth many times bigger and incomparably more numerous. In the Alps the Matterhorn is, perhaps, the peak whose destruction is most easily visible. Its eastern and southern sides pour down almost continuous falls of stones. Other mountains less commonly seen, such as the Bietsch-horn, are disintegrating even faster. In the distant future the Alps will be as rounded as the Welsh Hills, and the Himalayas will come to resemble the Alps of to-day.

Gigantic Falls.

Such changes involving great periods of geological time do not affect the prospect of human climbers, but the process of destruction does most particularly affect them. Every ridge and face of rock that is not protected by a mantle of snow or ice discharges its guns at frequent intervals, and from time to time gigantic falls occur which block ravines, dam rivers, and lead to great destruction when in due course the dams burst. It is owing to the multitude of falling stones that the rock-faces of the Himalayas are so plentifully scored with gullies, which look as though you might climb them but, in fact, cannot be approached. Where in the Alps a few stones would fall in the course of a hot afternoon, in the Himalayas there will descend great stone avalanches. It is enough to compare Alpine with Himalayan moraines to realize how much more actively the latter are being produced than the former. For these, and other reasons, Himalayan climbing is both more difficult

KANCHENJUNGA.

This peak affords one of the most magnificent mountain scenes in the world. Climbing in the Himalayas is more difficult and dangerous than in other ranges by reason of climatic and surface conditions, which present special problems to the mountaineer.

and more dangerous than is climbing in all the other mountain ranges of which we have knowledge.

The great agents of destruction are snow, sun, and frost, and the greatest of these is the sunshine. Though a thick and lasting mantle of snow preserves the rock beneath it, a thin layer, such as may be cast by a few days of bad weather, has a very different effect. Each little flake is a thing so light and delicate as to seem harmless, but its potential power is like dynamite. When the sun comes out and the new snow melts it percolates into every crack of rock, where the night's frost turns it into ice, at the same time increasing its volume, for ice bulks larger than the water of which it is formed. Thus into every crack a wedge is inserted which tends to break up even the most solid masses.

It would be difficult for anyone who has not experienced it to realize the intensity of solar radiation at high altitudes. When the air is only one-third (or less) of the density of air at sea-level and when it is utterly clear and dry, the sun's rays pass through it with little loss of power. As soon as the sun is hidden by shade or cloud, frost immediately sets in and is proportionately as fierce as the sunshine was hot. The higher the level the more powerful are the ice-wedges and the more rapidly are rocks broken up. The greater, therefore, the mountain, the swifter is its decay.

In additional to what I may call the structural difficulties of the Himalayas, the mountaineer has to face another and no less serious obstruction feature, to wit the monsoon. This is a wide current of damp air which drifts up in a north-easterly direction from the tropical ocean, passes right over India, and pours itself on to its northern mountain fastnesses. It comes, it passes, and it goes with great regularity. It breaks at Darjeeling in the latter part of June, and it dries up about the end of September, thus occupying practically the whole of what might be expected to be the climbing season.

This drifting and damp roof, ever almost at the point of precipitation, discharges the moisture of its lowest levels upon the plains and low lying country of India. When it reaches the foot-hills of the Himalayas they deprive it of its vapours at the next higher level.

As the foot-hills rise into mountains they continue the process, which is completed by the powerful condensing effect of the great Himalayan ridges. The air that passes on over Tibet is almost dry, thus accounting for the arid quality of the Tibetan climate.

It so happens that the Everest-Kanchenjunga part of the main Himalayan ranges thrusts its high peaks with a relatively sudden uplift far above its buttressing foot-hills, so that the damp air-drift impinges on the highest levels without having experienced any very considerable drying process. The precipitation of rain and snow upon these great mountains is therefore exceptionally heavy. Conditions improve as one goes westward and north-westward to and through Baltistan and the country north of Kashmir. Here the ranges open out like a fan so that several ranges, each broadly speaking higher than the one before, intervene between the Punjab plain and the culminating Karakorams. The monsoon passing over these ranges successively dries the air to higher and higher levels, so that it is only at very great heights that enough moisture remains to be precipitated by K.2 and its associated peaks. Into the valleys of Northern Kashmir no monsoon rain falls, and they are as desert as the Sahara itself. You have to mount to fifteen or sixteen thousand feet before coming to grassy uplands. For these reasons the further west and north he goes the less is the mountain explorer impeded by disagreeable and dangerous climatic conditions. Eastward around Everest and Kanchenjunga the conditions are at their worst. No one would choose that region for high climbing were it not for the two-fold challenge —Everest's, by reason of its supremacy in altitude; Kanchenjunga's by the splendour of its aspect as beheld from so commonly frequented a resort as Darjeeling. K.2 and the Baltoro peaks lie far out of the beaten track, and are never seen by the natives and visitors to India.

The Climbing Season.

Consider now how these considerations affect the prospects of a party that would climb Kanchenjunga. It has been generally assumed that the cold weather would be too severe for activity at high levels. It may be, and probably is so. October is generally a fine month in the mountains, and much fine weather is recorded throughout the winter. The same is true of the Alps, but those who have made winter ascents in Switzerland do not encourage the hope that much exploration of great mountains could be profitably undertaken at that season. Explorers, therefore, have been compelled to restrict their efforts to the month or two preceding the break of the monsoon in June. Once the monsoon has broken, climbing at high levels must cease. The latter part of April, the whole of May, and the first half of June have come to be regarded as the climbing season for Kanchenjunga, (although this year the Bavarians intend to risk an attempt two months later.) It is all too short when distances and altitudes are regarded. Moreover, in this relatively quiet season, violent local storms frequently rage and great falls of snow occur.

Falling stones are not the only, or, indeed, the worst artillery that opens fire on the climber. He has to face the barrage of avalanches, rare in the Alps but very common indeed in the Himalayas.

Risk of Avalanches.

Alpine climbers are accustomed to take this risk of avalanches not very seriously in the climbing season; but in the Himalayas no such casualness is permissable. If the Monte Rosa gully were in the Himalayas it not only might be swept by an avalanche during any given half-hour, but it almost certainly would be. I have myself watched no less than eighteen avalanches following one another in unbroken succession down what afterwards looked like a very mild and innocuous place. To expect avalanches everywhere was one of the first lessons we learnt in the Karakorams, and we gave future climbers plenty of warning of what they should expect. It was a wasted effort. My excellent friend, that great climber Mummery, faced by the temptation to cross an avalanche track on Nanga Parbut yielded to it, and was swept away when half across, though I had warned him of this very peril. That is an example how Alpine experience is liable to betray a Himalayan novice. Mr. Smythe, in describing the adventures of the last Kanchenjunga party, complained that the frequency of avalanches took them by surprise. It would not have done so if they had attended to the warnings of their predecessors.

The only further impediment to Himalayan ascents which remains to be mentioned is the rarety of the air. When the amount of air, and therefore also of oxygen drawn into the lungs at a breath is only about one-third of a sea-level supply, a serious situation is created. It must be met by more rapid and deeper breathing, and on occasion by the administration of a portable supply of oxygen, necessitating the carrying of a heavy apparatus. The Himalayan climber, therefore, should be a man of big lung capacity, and young enough to be capable of adjusting his body to new conditions. The chest can be expanded; the muscles of breathing can be trained to work faster. The whole rhythm of movement can be

modified so as to diminish sudden shocks and attitudes tending to compress the chest even for a moment. The Everest expeditions showed how, with time, remarkable adjustments were possible, and these adjustments, made by some men of exceptional physique, enabled them to live and work at the highest levels. Evidently Himalayan climbing is not every athlete's *metier*.

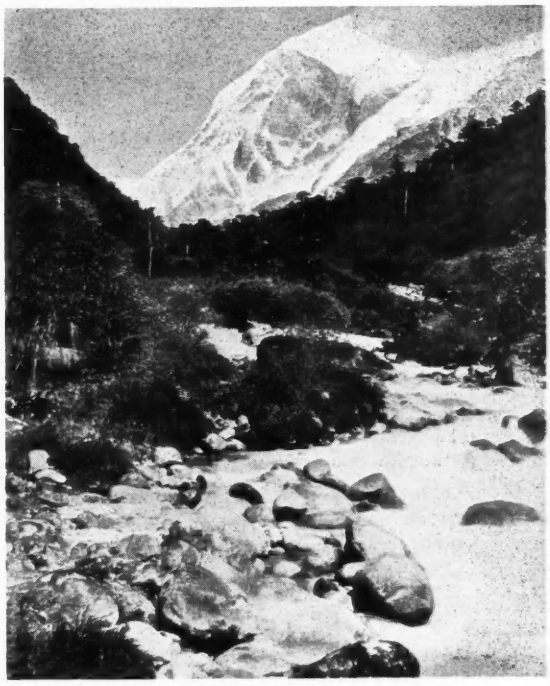
The Younghusband military expedition to Lassa in 1902 for the first time enabled parts of the northern front of the Himalayas to be seen and photographed by Englishmen. The photographs were few, and taken from considerable distances, but they sufficed to confirm the preconceived opinion that it was from the north that those mountains could best be approached. An encouraging feature of Kanchenjunga was a great and not too steep arête leading up to its summit. If this arête could be reached there appeared to be no merely climbing impediment to prevent an ascent by that route. I am told that if the mountain is ever conquered it will be by way of this ridge.

It is not a thing set with teeth and gendarmes, but is mainly crested with what appears to be snow. It is, however, almost certainly ice. The surface of new fallen snow at such altitudes melts rapidly in the hot sunshine, and permeates what lies beneath. The resulting snow-sponge must be frozen solid the first night. To cut ice-steps all along so great a ridge will be an affair not of hours but of a day or two. Where are the climbers to sleep? If anything is to be accomplished this way the ridge must be struck high up.

It is judged impossible to attain it from the Sikkim side by way of the Zamu glacier. An intervening range can be crossed, and the Nepal face can thus be with difficulty approached, a matter of no little trouble

THE ZAMU GLACIER.

Ascent by this route is deemed impossible. View showing the end of the glacier.



PANDIM FROM THE VALLEY.

Another famous peak is here viewed from the valley of Praig Chu.

with a big caravan laden with supplies for the season for a large party. The Nepal Government rendered this unnecessary. They gave permission for the second or international Kanchenjunga expedition to pass through its territory.

To explain the route followed, the difficulties and dangers experienced, and the altitudes attained is not possible here. Suffice it to say that once again an avalanche was the determining agent. It was unfortunately accompanied by loss of life. The attempt was of necessity given up. The party turned their attention to a peak of 24,000 feet, which they successfully climbed—the highest summit thus far trodden by the foot of man.

The Bavarian expedition which attacked Kanchenjunga in 1929 is to make another attempt this year, again under the leadership of Dr. Paul Bauer. Their intention is to make the ascent in August and September, thereby defying tradition by climbing during the monsoon season.

It is understood that Mr. Smythe now has his eye on another mountain in the Himalayas which appears to be free from the greater impediments which turned them back from Kanchenjunga. Success with the lower may lead to the higher. Let us wish them luck and wise prevision.

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A New Script from Ancient Syria.

By C. J. Gadd.

Assistant Keeper of Egyptian and Assyrian Antiquities, British Museum.

The discovery of cuneiform tablets just announced from Ras Shamra throws new light on the age of the alphabet. To explain these important finds, Mr. Gadd describes the excavations which French scholars are conducting. Further results will be awaited with interest, as many linguistic problems are involved.

About eight miles north of the town of Latakia, on the north Syrian coast, and almost opposite the long jutting point of the island of Cyprus, there is a little natural harbour now called Minet el-Beida; and a short distance inland from this stands a mound about 60 feet in height called Ras Shamra, that is, "Fennel Hill." These are the places, unmarked by any features except the bay and the hill themselves, which have lately produced a number of important antiquities, curious evidence of an extraordinary concourse of peoples and cultures, and one scientific surprise of the first order.

The initial discovery was made by an accident in the classic manner of such things—the plough of a peasant struck a flagstone and turned it over, revealing the entrance to a passage which led to a vaulted underground tomb, plundered of its contents. But the incident soon attracted attention, and finally was reported to the French Académie des Inscriptions et Belles-Lettres, which decided to send out an expedition to excavate at this new and promising site. Accordingly, Professor F. A. Schaeffer, of the Prehistoric Museum of Strasbourg, together with M. Georges Chenet, was placed in charge of the work in the spring of 1929. It soon appeared that an ancient cemetery had occupied part of the ground between the hill of Ras Shamra and the sea, and that the principal dwellings were, as might be expected, on the hill which owed its existence, as usual in the East, to the accumulating ruins of long-continued settlement. The work, therefore, was divided into two parts, the excavation of tombs on the lower ground about the shore of Minet el-Beida, and the clearing of buildings on the mound of Ras Shamra itself.

Cypriote Pottery.

The northern section of the cemetery, nearer to the coast, proved to contain not so much a cemetery at all (for no human remains were found there) as a series of separate deposits mostly of pottery, a good deal of which was unbroken. Among this pottery were many Cypriote importations and some local imitations of the same, and also other vessels, either Egyptian or showing Egyptian influence. The latter was much more strikingly attested by a group of objects which seem to have been placed as a foundation deposit under the wall of a building now almost disappeared. There was a bronze figure of a hawk wearing the tall double crown of Upper and Lower Egypt, a second smaller hawk with gold inlay decoration holding the uraeus between its feet, and a small figure of a seated god with inlaid eyes; all of these are characteristic imitations of Egyptian work, but not without some of the misunderstandings and confusions which always marked the Phoenician use of foreign types.

Many Influences.

Not far from these figures again there were found two other divinities, this time more purely Asiatic; a bronze statuette about nine inches high of a striding god, with right hand raised and left stretched out before him. The god bears a very high crown, which, together with the face, is covered with a sheet of gold leaf. He has also silver armour over the body, arms and legs, and a golden bracelet on the right arm. With him there lay also a gold ring, and a gold pendant decorated with a representation of a naked goddess, holding a lotus sceptre in each hand, and having on the head a form of head-dress like that of the Egyptian mother-goddess Hathor. When it is added that most of these deposits either consisted of, or were accompanied by, a wealth of pottery, some Cypriote, some native ware, but a good deal also of Mycenaean, it will already be seen what a mixture of populations and what a wealth of influences was to be found at this Syrian port—the natives of the land, rooted in the religion and culture of western Asia, which derived mainly from Babylonia, but brought into intimate contact with the persons and ideas of many different lands, Hittites from Asia Minor, Egyptians with their strange and individual art, Mycenaeans from the lands of the Aegaean, with yet another set of religious and artistic formulae, as well as a strange language, but

particularly Cypriotes, whose nearest point on the mainland was this little harbour of Minet el-Beida.

The southern part of the ground between the hill of Ras Shamra and the sea was found to be more definitely a place of tombs. Beside the tomb discovered accidentally in 1928 there came to light two or three more of the same type, though all but one were either incomplete or much ruined. The most perfect, however, was very well preserved. It was an underground chamber, built throughout of carefully dressed stone, with a round-arched doorway and a roof built of corbelled blocks of stone; one of these had been removed in ancient time, perhaps soon after the occupants of the tomb were laid there, by thieves who had broken in thus through the roof and rifled the precious contents. The true approach to the chamber was by six stone steps, upon each of which, close against the side walls, had been laid offerings for the dead, one Egyptian alabaster vase, and many Mycenaean pots which had no doubt contained food and drink. These were undisturbed, for the robbers had not got in by the proper entrance.

Within the chamber their depredations had left but little of value; there was no sarcophagus and even very few bones. In remote corners, however, they had scattered or overlooked a few small objects of value—beads and rings of gold, silver, or iron, but particularly a small oval ivory box with a lid bearing a most characteristic Mycenaean sculpture. A seated goddess, naked to her waist, wears the voluminous and many-flounced skirt in which she appears, for example, on the bezels of gold rings from Greece or as the Snake Goddess of Knossos.

Cross-roads of Civilization.

It may be considered certain that the deposits in the tomb, if they had survived, would have included many splendid works of Mycenaean art, as well as many native products, and something too of Egyptian. Everything, indeed, goes to confirm the idea of cosmopolitanism which these discoveries suggest. The princes and people of North Syria lived at the very cross-roads of all the civilizations of the ancient world, and at a time when inter-communication was particularly active. For all the material which can be dated by discoveries elsewhere agrees in marking the most flourishing time of this city as the thirteenth and twelfth centuries before Christ, when the late nineteenth and twentieth Dynasties, the long line of Rameses, were reigning in Egypt. The great Hittite empire had already collapsed before the "Peoples of the Sea" which probably had left much of their Mycenaean influence at Ras Shamra, and the times were propitious for the flourishing of such petty states under their own princes until the Assyrian came, about the end of the twelfth century, and involved the whole of Syria in a ruin from which this place at least never recovered.

The 1930 Expedition.

Such an end was shown to have come upon the city and the port when the mound itself was explored. Foundations of an important structure, built of carefully worked stone blocks, were soon encountered, and part of the original plan was revealed. Work was continued here by a second expedition in the spring of 1930, and the building was found to be a large temple, with two great courts lying side by side. In the northern court there was a stone bench upon which had stood granite statues of gods represented in Egyptian style. But the gods of Ras Shamra were as strangely composite as the whole civilization which prevailed at the place. One, represented in relief on a stone stele, displays perhaps the most uncouth divine figure that western Asia has yet produced. His costume is an incongruous mixture of elements, chiefly Egyptian and Hittite. The head-dress is a tall Egyptian crown, with feathers and an odd curly horn, his hands grasp respectively a spear and a crooked Egyptian sceptre, around his middle is a kind of Hittite kilt with a great dagger stuck in the belt, and Hittite also are his shoes with the upturned toes. This is presumably a representation of the local god or Baal, whom people of different traditions pictured after their own conception, for he appears in orthodox Egyptian dress upon a stele dedicated to him by an Egyptian officer, Mami, who calls himself a "royal scribe and treasurer," and, what is most important, calls the god "lord of Sapuna." Since this name occurs also upon another Egyptian fragment found in the temple, it may be supposed that Sapuna was the ancient name of the city at Ras Shamra; if so, nothing more seems to be related about the place, for it does not figure in the Amarnah letters, which convey so much information about Syria in a rather earlier age.

Whatever be the name of the place, and however it may hitherto have escaped mention in ancient history, its importance as a point of contact between the Asiatic and Aegaean worlds, not to mention the Egyptian, is made abundantly clear by the excavations. The strength of Cypriote elements in the population is sufficiently explained by the nearness of the place to the extreme point of Cyprus, and the existence of a natural harbour there. Cyprian ships desiring to cross to Syria would hug the shore until

the last moment, and then take the shortest passage across to the coast which would soon have become visible to them—this would bring them almost directly to the harbour at Ras Shamra. In a communication to the Académie when the first results of the excavation were announced, M. René Dussaud pointed out that this connexion is attested, in a mythological form, by the Byzantine historian John Malalas of Antioch, who wrote in the seventh century A.D. but naturally drew from more ancient sources.

An Important Find.

Of all the discoveries made at Ras Shamra, however, nothing equals in importance certain clay tablets which were brought to light in a building south of the temple already described. In various rooms arranged around a courtyard these modest-looking relics were found buried in the ruins. But all excavators in the East know that these things are their most precious finds, for by them the past speaks directly to us as it cannot otherwise by even the most consummate works of art. Upon clay tablets one expects to find the cuneiform writing of Babylonia. The great surprise that Ras Shamra had to reveal was an entirely new kind of cuneiform writing, modelled upon but altogether different from that of Babylonia.

The ordinary cuneiform writing may roughly be described as syllabic; it does not write letters like *a* and *b*, but only syllables like *ab* or *ba* or *bad*. Thus it is necessary to have a great many characters, since the sign *ab* is entirely different from *ba*, and so forth, and, in fact, there are several hundred signs regularly used in Babylonian cuneiform. At Ras Shamra certain tablets were written in this complicated script, which had been current in Syria for centuries, and with which the local scribes were evidently familiar, but most of the tablets were written with a small number of characters (twenty-eight in all) in which the wedges were combined in an entirely new way. Since only twenty-eight different characters could be found upon these tablets, it was at once apparent that they must form an *alphabet*, not a syllabary, for in no other way could so few characters be enough to express everything that it was desired to write.

Here, then, was a problem for the decipherer—he had to find the values of twenty-eight entirely unknown symbols and read the texts written by means of them. Stated thus baldly the task might seem impossible, but the student was not wholly without resources. He might justifiably assume that he had to do with a Semitic language, and then, too, there are certain scribal methods and hints to be got from the very appearance of a text with which the expert grows familiar. Hence it is possible to give a shrewd guess at what a certain line or phrase means, and thus, putting the Semitic word for this, a working hypothesis may be laid down which further study will confirm or correct.

As concerns the Ras Shamra tablets, only a few have yet been published, but it is understood that the new alphabet has now been satisfactorily made out with the help of fresh material. The contents of these texts are stated to be of the utmost interest, comprising not only accounts and lists, but letters and religious compositions, which introduce the names of local gods such as Ashtart, Dagon, El-Hokmot, *i.e.*, "God of wisdom," and Din-El, or "judgment of God." Another text, of about 800 lines, is said to be a kind of epic poem, the hero of which bears the name of Taphon. One must not forget to mention also the presence of a "syllabary," or lexicon, written in ordinary cuneiform, in which are explained words belonging to what is described as an entirely unknown language. It would be fascinating to speculate that this might be the long-sought "Minoan," the language of Crete and the isles, but for this the publication of the eminent French scholar who is studying the tablet must be awaited.

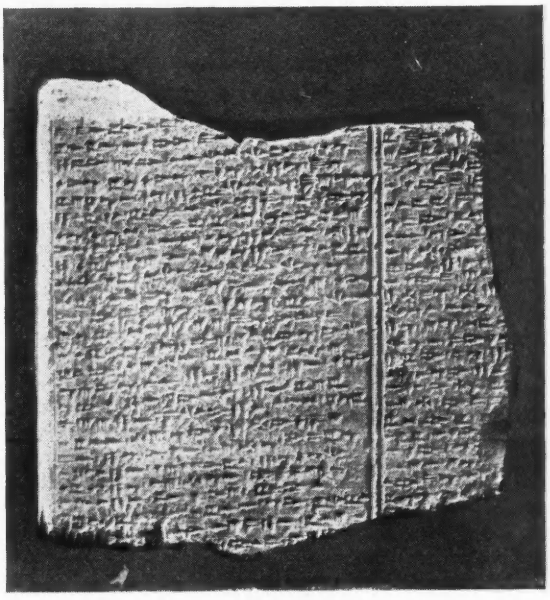
Behind these literary details, which seem remote enough from us, there is an interest which has a very direct concern with modern civilization. The invention of the alphabet was perhaps the most potent discovery ever made. In a moment it reduced writing from an abstruse and laborious accomplishment to something within the range of the most moderate intelligence and industry. In the late sixth century before Christ the Persians had devised out of the cuneiform script a new set of thirty-nine signs which were used practically as an alphabet for writing Persian, but the notion of this was plainly got from the Aramaic or Phoenician alphabet which had at that time long been familiar. But now we find at Ras Shamra, six or seven centuries before, that a similar but even more drastic simplification of the cuneiform had already been made and was being applied, moreover, to a Semitic language. Was this also under the influence of the Phoenician alphabet?

Origin of the Alphabet.

The Greek letters, and hence, by various modifications, all European alphabets used to-day, were adapted from the Phoenician letters, which form, so far as is known, the first alphabet ever invented. There has been long and inconclusive argument about the invention or ultimate origin of this wonderful

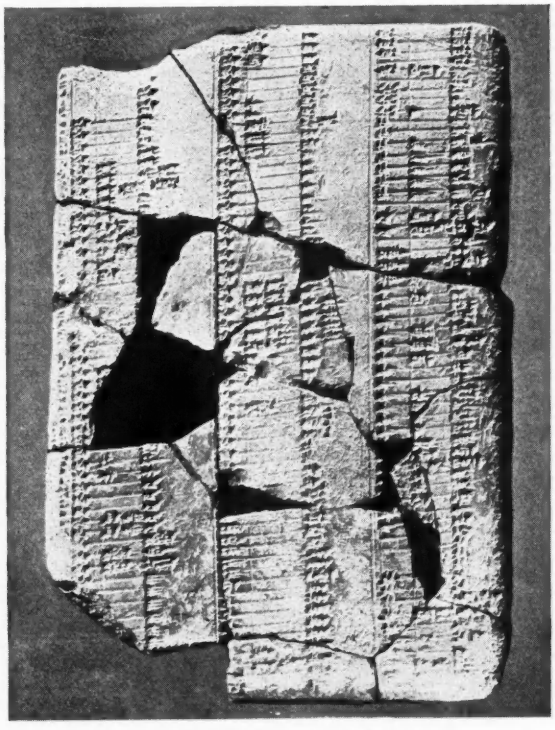
instrument, and various scholars have contended with ability and enthusiasm for its development from all the systems of writing known to exist in the lands bordering on the eastern Mediterranean. Egyptian hieroglyphs have been claimed as the source, so has the cuneiform script, so also has the more lately discovered and still undeciphered writing of Crete. In recent years it has been thought that certain monuments of the Sinai peninsula showed the process by which the Egyptian hieroglyphs were forming into the new characters, and hence opinion has swung back towards Egypt.

As for the Phoenician alphabet itself, until quite lately it was not attested much before the ninth century B.C., the date of the famous Moabite Stone. Not many years ago, however, a well-developed Phoenician inscription was found upon the coffin of Ahiram, a king of Byblos, which coffin was dated by the objects found along with it to the thirteenth century B.C., about the same time, indeed, as that of the Ras Shamra tablets. So surprising did this drastic putting back of the alphabet's age appear that strong doubts were expressed whether the accompanying objects were necessarily of the same time as the coffin, and whether the latter was not a subsequent intrusion. The most competent opinion, however, adhered to the earlier date, and it is this which will find great support in the Ras Shamra tablets.



THE NEW SCRIPT FROM RAS SHAMRA.

Fragment of a tablet inscribed with the new alphabet, which contains twenty-eight characters. (Copyright photographs by Professor F. A. Shaeffer, 1930.)



A DICTIONARY 3,000 YEARS OLD.

The words are written in two languages and provide a key to an hitherto unknown language, one of the many discoveries at Ras Shamra.

These tablets, indeed, tell us nothing of the origin of the Phoenician alphabet itself, for their characters have no likeness to the Phoenician characters, and it would be very rash to say that they create any presumption that the Phoenician letters were made out of cuneiform. What they do suggest is that in the thirteenth century B.C. the alphabet was already known, as Ahiram's coffin had indicated, probably in very much the same form as it is found on that coffin which does not, in fact, differ very widely from that of the Moabite Stone.

The Ras Shamra alphabet is most probably the invention of a scribe schooled in the Babylonian cuneiform, alive to the convenience of the alphabetic method, but unwilling to give up his clay tablet and stilus, which, nevertheless, he finds very ill-adapted to the linear shapes of the Phoenician characters, and thus he devises wedge-combinations of his own for the same purpose. So much for his convenience and his contribution; but we have still to continue the search for the origin, perhaps the genius, which produced, not so much the Phoenician letters, but the idea of the alphabet.

Ten Years' Research on the Prickly Pear.

By C. Schindler.
University of Brisbane, Queensland.

The biological control of prickly pear was first attempted in Australia as early as 1912, but it is during the past ten years that the problem has been dealt with systematically. This branch of research has met with considerable success, and methods suitable for other weeds have also been developed.

THE members of the cactus family which are collectively known in Australia as "prickly pear" are those which have become more or less of a pest and are spreading rapidly throughout the country. The greater part of the pear infestation is in Queensland, and it extends some distance into northern New South Wales. In 1927 it was estimated that an area of over sixty million acres was covered by it, and that it was spreading at the rate of a million acres a year; this area is now being considerably reduced, as the result of the introduction of many useful insects which feed on the pear and in various ways reduce its vigour, in many cases finally killing it. Most of the land on which the prickly pear has become a pest is natural grazing country, but land suitable for tropical and sub-tropical crops, such as cotton, is also infested.

The great problem in the control of prickly pear lies in its rapid rate of spread, the density of the infection, and the low value of the land it infests. It grows best in country with a high average temperature and an annual rainfall of less than twenty inches, most of which occurs in summer; hence its southward spread is limited by increasing winter rainfall and cold winters, and its northward spread by high annual rainfall. The large "joints" or "pads" which in these plants take the place of leaves may, if detached from the plant, be carried long distances by water or animals, and on reaching the ground will throw out roots and develop into new plants. Many birds and animals eat the fruit; the seeds, being resistant to the action of the digestive juices, will germinate after passing through them.

The Chief Pests.

Like most pests in Australia, both plant and animal, prickly pear is an introduction. A large number, mostly species of *Opuntia*, have been acclimatized here, but of these only about six are of importance as pests. Two of these cover practically the whole of the pear country; these are *Opuntia inermis*, the common pest pear, covering five-sixths of the area, and *O. stricta*, the spiny pest pear, which is next in importance. The first prickly pear was introduced by the first colonists in 1788, apparently for the purpose of developing the cochineal industry. This did not succeed, however, and the pear then introduced has not become a pest. The later introductions were made, unfortunately, without their natural enemies, and hence they have been able to spread until checked by climatic conditions. In some localities, prickly pear has been useful as a source of fodder in times of drought, the plant being lightly burned or put through a chaff-cutter to destroy the bristles.

First Steps.

In 1912, the first steps towards biological control were taken by the Queensland Government, which appointed a Commission to investigate the natural enemies of the plant. This Commission introduced a cochineal insect, which rapidly destroyed one of the minor pest pears, and also did some work in preparation for further introductions. In 1919, an agreement was made between the Commonwealth Government and those of Queensland and New South Wales for the further investigation of the problem; this agreement has been renewed several times, and work is still being done by the organization set up in 1919. The problems involved were entirely new; the only previous attempt at the biological control of a plant pest was carried out on a much smaller scale with lantana in Hawaii. Suitable insects had to be found and methods developed for discovering their possibilities and for their transport to, and acclimatization in, the Australian prickly pear areas. It appears that this work has now succeeded, and the pear is retreating before the attacks of a number of introduced insect enemies.

The Commonwealth Prickly Pear Board, which has controlled the work since 1919, has conducted a thorough search for useful insects in the native home of the prickly pears, that is, Central and South America and the West Indies. When promising insects are found, it is necessary to ensure that they will not attack crop plants after the pear has been destroyed.

BEFORE—
Prickly pear before the introduction of Cactoblastis.

—AND AFTER.
The pest completely destroyed by the caterpillar.

This is not a likely eventuality, since the pear plant is different from most cultivated plants in that it is very succulent, and the family to which it belongs is not closely related to any of the families of economic value. It is necessary to make complete and exhaustive tests, however, before an insect can be considered safe. This is done by placing the insects in a cage with no food except the plant for which they are being tested. If the insect eats this, it is rejected as a possible agency in biological control; if it starves to death rather than attack economic plants, the work is continued.

The next step is to breed several generations of the insect till it is free from any possible parasites which may reduce its efficiency as a control. When this has been done, the most difficult part of the work remains—transport to Australia and acclimatization there. The insects are placed in cages which contain the pear growing in moss; this is kept damp throughout the voyage. On arrival at Brisbane, the insect must become adapted to the changed seasonal conditions which it encounters on removal from the northern to the southern hemisphere. In some cases, a number of shipments had to be made before the introduction succeeded, and the life history of the insect had to be studied in determining the most suitable time of transport. When the insect has become acclimatized, further tests on crop plants are carried out, and if the insect proves to be dangerous, all specimens are destroyed. When the tests are completed, the insects may be liberated in the field and allowed to multiply. The method of liberation varies with the different insects, and comparatively few of the introduced species have proved to be well adapted to the field conditions in Australia; these have done some wonderful work, having been freed from their natural parasites.

There are many risks involved in the introduction of the insects, but they have been greatly reduced by carefully following the methods outlined above. However carefully parasites are eliminated, it is possible that native insects may attack the introduced species; this has occurred to a small extent in several cases. It is also possible that, in spite of the thorough tests carried out, an insect will, under field conditions, attack crops when the prickly pear has been destroyed; a few cases of the destruction of green tomatoes by Cactoblastis grubs have been reported.

For the purpose of investigating promising insects in America, a station was established at Uvalde, in Texas. The whole of the cactus belt of the U.S.A. was examined, and about seventy different kinds of insects were found on the prickly pear, many of which were new to science. Mexico, the West Indies and Argentina were also exploited; two useful insects, the Indian cochineal and Cactoblastis, were obtained from South America. The study of life histories, tests on crop plants, and the work of freeing the insects from parasites were carried out at this station. In Australia, these phases of the work are continued by a station at Sherwood, near Brisbane. When an insect has proved satisfactory, a large number of individuals is sent to the field stations for liberation and acclimatization. There are three such stations: at Gogango, near Rockhampton, at Chinchilla, Queensland, and at Gravesend, New South Wales.

A CROP OF BARLEY.
The introduction of Cactoblastis has made possible this crop of barley. It is grown on land cleared by the grub, and yields ten tons per acre.

An account of the equipment at these field stations will give some idea of the magnitude of the work. They are now being used chiefly for the breeding and liberation of the boring caterpillar Cactoblastis. At Chinchilla, where the author was working for some time, there are four large iron sheds, each containing about eighty cages eight feet by four feet

by three feet deep. These are covered with fine wire gauze, and contain pieces of pear in damp sawdust. The country round the station is infested with *Opuntia inermis*, on which Cactoblastis was liberated some time ago. When the caterpillars are pupating in this, the cocoons are collected and placed in the cages, being watered lightly in hot dry weather. As the moths emerge from the cocoons, they lay their eggs in chains on the pear. The eggs are collected each day and their approximate number is determined by weighing. They are then prepared for liberation. With this method of daily collection, the time at which the eggs will hatch out is known, and they can be kept in a safe place until just before this time, thus reducing the loss that would occur if they were put on the pear immediately. The eggs are often sent long distances, and are liberated by specially appointed prickly pear rangers. When the cocoons are numerous, well over a million eggs may be collected in a day at a field station.

A Striking Success.

Probably the most spectacular success is the moth Cactoblastis cactorum, of the family *Pyralidae*. It was found in 1914 at La Plata, but the caterpillars brought to Australia died. It was re-discovered in 1925 by A. P. Dodd in Argentina and Uruguay, and a shipment of three thousand eggs early in that year reached Australia safely and was an immediate success. The caterpillar tunnels into the pear, eating out the inside of the pads and finally causing the plant to collapse. It attacks both *Opuntia inermis* and *O. stricta*, and is easily bred in cages. It has two generations a year, a long winter one and a short summer one. The eggs are small and white, and are laid in chains of about eighty eggs, attached to the pear by one end. This method of egg production makes the handling of the eggs very simple. The caterpillar grows up to two inches in length and is of a bright red colour with black spots. It lives gregariously inside the pear pads and is thus protected from birds and other enemies. It spins a white cocoon under dead pear or rubbish, from which a small greyish moth emerges. The adults do not apparently require any nourishment; they emerge usually at night, mate, and lay their eggs the next night, dying soon afterwards. This insect has done wonderful work in destroying the pear, especially where it has been weakened by the attack of the cochineal scale.

A number of species of scale insects, *Dactylopius spp.*, collectively known as cochineals, have been utilized for prickly pear control. These have been thoroughly distributed, and are doing useful work throughout the infested area, especially on dense growths. Some bugs of the genus *Chelinidea* have been introduced; of these, *C. tabulata* has proved most suited to Australian conditions, and is to be found in large numbers where it has been liberated. It weakens the plant by sucking the sap, leaving small round pale areas where its rostrum has been inserted. Its chief action is in preventing the pear from forming fruit. The prickly pear "red spider," *Tetranychus opuntiae*, is a native of Texas, and appears to be a specialized strain of the red spider which attacks roses, beans, and other cultivated plants. It prefers *Opuntia inermis*, and weakens the plant by destroying the young growth. It is particularly useful in conjunction with the cochineal scale. Some work has been done on fungous and bacterial diseases of this pest, but it has been overshadowed by the importance of the entomological work. The dry hot climate in which the pear flourishes does not appear to favour the development of these diseases on a large scale, but they have been useful in completing the destruction of plants attacked by Cactoblastis.

Since the beginning of systematic work on this problem in 1920, a great deal of success has been obtained and methods suitable for work on other noxious plants developed. It is now estimated that instead of the pear spreading at the rate of a million acres a year its area is being reduced at this rate, largely as the result of the successful introduction of Cactoblastis. Since 1925, large numbers of this insect have been liberated in the prickly pear country, and it is now considered that it can be left to spread of its own accord and will before long destroy all the pear, provided that nothing unexpected, such as an epidemic among the caterpillars, occurs. Unless a bush fire destroys the enemies of the cactus, land on which the old plants have been destroyed will be completely free in four years; this period is necessary in order to ensure the destruction of seedlings and suckers which may appear when the original plants have been killed.

Choice of Crops.

In some areas, the work of the insects has advanced sufficiently to make it desirable to consider the choice of crops to be grown on the cleared land for the grazing of cattle and sheep. Experiments are being carried out at Palardo, near Chinchilla, on the provision of both summer and winter feed. The trees are being poisoned with arsenic, and the seed sown on the rotting pear. Good growths of lucerne, rape, wheat, oats, and other pasturage have been obtained, and the possibility of the profitable use of the cleared land has been convincingly demonstrated.

The Achaemenid Art of Persia.

By Stanley Casson.

The author deals with a phase of Persian art that is not fully described in the literature of the Exhibition now being held in London. Little is yet known of the work of the Achaemenidae in the sixth and fifth centuries B.C., *though it was evidently of great importance in the development of the national art.*

MANY of those who have visited the Persian Exhibition have wondered exactly what is indicated by the term "Achaemenid art." Most people have some knowledge at first hand of the great mediaeval phases of Persian painting and metalwork, but in general the art of the ancient dynasties of Persia is but little known. That of the Achaemenidae, or the sons of Achaemenes the founder of the greatest dynasty in Persian history, is unfamiliar partly because the amount of material with which to illustrate it is so scant, and partly because little or no systematic and scientific excavation has been carried out in Persia upon sites of the Achaemenid period, or in fact upon any sites at all of the historical period. The result is that the art of Persia for all the historical periods is in much the same position as that of China. Practically all the best known objects of Achaemenid, Parthian, Sassanian and Islamic times before the Mongol period, have reached collections and museums through the unsatisfactory medium of the local *antikadji* and the big art dealers of Europe and America.

Pleasant though it may be to have these works of art, it would be more pleasant still if they were accompanied by scientific and precise evidence as to the place in which they were found, the objects found in association with them and the circumstances of their discovery. But, as things are, we are compelled to build up our knowledge of the major part of the art of Persia from the isolated objects which have been collected in various ways. Just as the art of the Han and Tang and Sung dynasties of China have to be studied without the assistance which archaeological enquiry, strictly controlled, might have afforded, so that of early Persia has to be laboriously, and sometimes precariously, reconstructed from what chance has thrown into our hands.

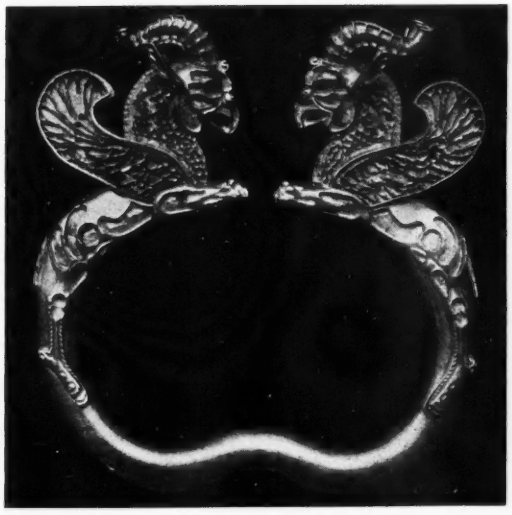


FIG. 1.
ARMLET FROM THE OXUS TREASURE.
The ends of this superb object are in the form of winged monsters, whose surface cavities were originally filled with coloured precious stones.

Fortunately for our knowledge of the art of Persia during the reigns of the greatest of the Achaemenid kings—Darius I, Xerxes and Artaxerxes—there survives a series of monuments which can be dated accurately. These monuments are carved in the native rock and, in consequence, are almost indestructible, and they are sufficiently decorated with artistic reliefs and devices to enable us to get an exact knowledge, at certain fixed periods, of the styles and fashions of the contemporary art. Without these our information would be far less satisfactory. But the preservation of the monuments is due not to the efforts of art-lovers or archaeologists so much as to the determination of their builders that they, like the builders of the Parthenon, were building and carving for all time and not for one age alone.

Foremost among these monuments is the mighty commemorative relief, with its long and impressive inscription, cut in the cliff face at Behistun, on the road that ran from Ecbatana to Babylon. By this we can judge the art of the time of Darius the Great, the king of kings who almost succeeded in absorbing Greece into his great empire. Of equal value are the reliefs from the tomb of Darius at Persepolis, which stands to-day almost as fresh as when it was first cut. Here are twenty-six figures, each representing one of

the twenty-six nations in the empire of Darius. Of the same age but of another two generations as well, are the various stone reliefs and winged bulls from the Palace of Persepolis.

From Susa come some superb columns whose capitals are carved with bulls and volutes. These belong to the time of Artaxerxes II, who came to the throne in 404 B.C. Some fine specimens of this architecture are preserved in the Louvre in Paris. Of great value also, though not germane to the subject of this article, is the great relief cut next to the tomb of Darius on the same cliff-face by Sapor, or Shapur, the Sassanid King, who effected the greatest victory in the whole history of Persia by capturing a Roman Emperor, the unfortunate Valerian, in the year A.D. 260. The relief shows the Emperor kneeling before the Persian king in surrender, and the whole relief constitutes one of our most valuable records of Sassanid art.

With the evidence thus accumulated of the style of Persian art of the fifth and fourth centuries B.C. we are thus able to some extent to atone for the lack of authentic archaeological information. From what we have we can at least attempt a classification of those various isolated examples of Persian art which have drifted into the collections of Europe and America.

The largest single group of such works of art is, of course, the famous Treasure of the Oxus, which the British Museum was fortunate enough to acquire shortly after its discovery in 1877. Its romantic history is too well known to describe here; its importance lies in the fact that the bulk of the Persian objects that it contains are all attributable to the fifth and fourth centuries B.C., although there are objects both earlier and later in date. The whole treasure, which was found in Turkestan on the sandy shores of the river Oxus, seems to have been an accumulation of family treasure which was hidden in some time of trouble. Among the various objects were heirlooms of earlier members of the family. The whole treasure is now specially exhibited at the British Museum and, in fact, contributes far more to our knowledge of Achaemenid art than do the silver and gold objects at Burlington House.

There are, however, two objects at Burlington House which belong to the Treasure, one a superb bracelet the ends of which are in the form of winged monsters (Fig. 1), with surface cavities which were originally filled with coloured precious stones. The other is a small gold chariot which is similar to another in the British Museum. The bracelet was acquired by the South Kensington Museum from Colonel Burton, who was the political officer originally responsible for the rescue of the whole treasure from the Khyber robbers who had looted it from a caravan. He was allowed by the grateful merchants to retain this one object. The chariot had already left the treasure when it was sold and found its way independently into the collection of the Earl of Lytton. Another stray piece, which was also once the property of Colonel Burton, was recently sold by auction.

FIG. 2.
WINGED IBEX IN BRONZE.
This figure was discovered in Armenia and served as the handle of a vase. The face and wings of this lovely animal are in gilt.

In the Treasure is a variety of works of art of different kinds. Some are Scythian, some barbaric Bactrian, but the bulk is Persian. Gold statuettes, plaques, bracelets and an ibex vase-handle of parcel gilt on silver, together with a fine group of finger rings and engraved seal stones, throw more light upon Achaemenid gold work and modelling

than any other single find. The two statuettes at Burlington House in gold and silver, one a standing Persian King, the other a mounted horseman, must be studied in the light of the Oxus treasure. There is also a silver Persian warrior which comes, strangely enough, from Sicily. But the superb winged ibex in bronze (Fig. 2), with gilt wings and face, found in Armenia, which has been lent by the Berlin Museum to Burlington House, is finer than the Oxus ibex. This ibex is one handle of a vase; the other handle, exactly similar, is in the Louvre. Figures of goat and ibex are frequent in Achaemenid art, and reflect the same style and artistic conception that is seen in the bull-columns from Susa.

Similar heraldic animals occur on engraved seal stones of the Perso-Ionic class. One such, from the Oxus treasure, has a double-headed bull in the same manner, and this Persian animal-style seems even to have infected the coinage designs of East Greece, for it is found on the coins of Lesbos. There are also several fine gems in European museums which show a Persian monarch hunting the ibex. In each case the ibex is of the same type as that shown at Burlington House.

One of the finest examples of this animal-style is seen in the case of a silver vase now in the National Museum at Sofia. The vase has two handles, one an ibex, the other a lion. It was found in a princely burial of the fifth century at Duvanli in Bulgaria, accompanied by Thracian and Greek objects, by which it can be dated. It is, therefore, of more scientific value than most of these fine works of art. But the organizers of the exhibition seem, somehow, to have missed it, and it was not sent to London. Its importance is the more obvious when we consider that it must have reached its Thracian owner either through the medium of one of the Greek cities of the coast, or else during the time of the Persian domination of Thrace direct from a Persian satrap. The very Greek character of the body of the bowl of this vase suggests that there may be some truth in the view that these vases were made by Greeks and not by Persians, but in the style demanded by the Persians.

FIG. 3.
HEAD OF AN ACHAEMENID KING (LIFE-SIZE).
This is by far the most important monument of Achaemenid art in existence. It was found in north-west Persia, but other information about it is not yet available.

But by far the most important monument of Achaemenid modelling, or indeed of Achaemenid art at all, is the magnificent head in bronze, life-size (Fig. 3), which is lent by the Brummer Gallery of New York. Here is a portrait, perhaps the only realistic Persian portrait in ancient Persian art, of a prince or king, perhaps Darius I himself, which is evidently derived from a life-size statue. It gives us the first information we have as to the existence in Achaemenid Persia of bronze sculpture of this kind. Nor is it possible for a moment to class this as Perso-Ionic or Greek, or, in fact, as anything except native Persian art. But, as in all examples of Achaemenid art, there is perceptible in it the influence of many of the periods of art of other countries and ages, which went to make up that very mixed style which Persians favoured. In this portrait is something Sumerian, something Assyrian, something Hittite, and nothing at all that is Greek. It illustrates Achaemenid art better and more clearly than any other specimen. And it shows that there did, in fact, exist portraits in the art of ancient Persia, a fact which has not as yet been fully established. It was found in north-west Persia, but there is no other information yet available about it.

It remains to summarize the characteristics, as far as we can establish them, of Persian art of this period, the period of greatest power and conquest that Persia has ever seen.

Firstly, it is evident that the Achaemenid age was not an age of superlatively fine art. All these works of art are good, some superb, but, nevertheless, compared with the art of Greece at the same time, or of Italy in the fifteenth century, Achaemenid Persia had an art that was not great. It was gifted and it was interesting, but its eclectic nature showed that the genius of Persian artists lay in adaptation rather than in invention. In comparison, the art of Safavid

Persia was far more individual and creative. The Aryan Iranian peoples who had conquered Persia and established the Achaemenid dynasty cannot have been a naturally artistic people. For, after their conquest, they did not impose a style of art upon a conquered people, so much as absorb from the conquered region the styles of half a dozen different races and periods. Nor (unless we except the bronze portrait just described) has there survived to us any work of an obviously outstanding master.

In the friezes of the Susan and Persepolitan palaces and in the reliefs of Darius we get the flavour of Assyrian art but devoid of Assyrian strength and virility. Persian lions and bulls are formal and stiff; Assyrian animals, although conventionally rendered, are done with amazing comprehension and vitality. Greek influence is everywhere perceptible, but nowhere evident. The Persians could not have avoided Greek influence if they had wished, for Greeks were everywhere in the Persian Empire and Greek imports penetrated far and wide. Yet the Persians avoided Greek control. They were as independent artistically as politically of Greek lands, but in matters of technique and detail the Greeks were clearly their masters. In the art of the silversmith, the goldsmith and the jeweller, the Persians did indeed show both originality and invention, but it takes more than this to make a great national art.

A Great Invention.

Nevertheless, one great invention of craftsmanship comes down to us from early Persia, if nothing else, namely, the craft of *cloisonnée* and "encrusted" jewellery. Persian goldwork such as the Oxus armlet (Fig. 1) show the earliest known form of jewellery with inset stones and gems. This style had a great popularity in Persia in this and succeeding periods and lasted down to Sassanid times. It was then adopted by Romans at the close of the Roman Empire, and from them spread to the Goths of South Russia. Thence it spread all over west Europe and gradually changed into the craft known as simple enamel-*cloisonnée*, in which the enamel took the place of the inset stones. Where precisely this process was invented is unknown, but in the King Alfred's jewel at Oxford we have one of its earliest instances. Constantinople adopted the style in the ninth century and Byzantine *cloisonnée* plaques are among the finest specimens of ancient gold-craft. Thence it spread to the Rhine and the Meuse valleys whose schools of enamel work were long famous in the Middle Ages.

But throughout Achaemenid art there runs a certain grandeur, as if the artists were always working in the grand manner, with the memory of great Darius always in their minds. This is the hall-mark of Achaemenid art. Its little gold and silver statuettes may be odd and barbaric; its relief carvings may be rigid and harsh; its coloured tile walls with their strange beasts and dragons and griffins may be uncouth and savage, judged by Hellenic or occidental standards; but in them there is always some hint of the greatness of the people who brought about their creation, some hint of that deliberate creative impulse that stamps all peoples of Aryan origin. The bronze and silver goats and ibexes are works of supreme charm and skill. The armlets and intricate gems and jewellery are works of an old established and long perfected craft. But the bronze portrait of the Persian king or prince shows a genius that transcends the perfection of Achaemenid craft.

Research Needed.

At present our knowledge of Achaemenid art is limited to what we have learned for the most part from fortuitous discoveries. A systematic search for tombs of the early period and for sculpture, other than the decorative sculpture of palaces and temples, may bring to light indications of independence such as can only be *inferred* from what we have at present. Persian art was, indeed, a "mixed art," more mixed perhaps almost than any other. Yet, even so, the greatness of an art, like the greatness of a people, may come from its admixtures and impurities. We are not justified in assuming that Persia borrowed too much to permit herself to develop her own native genius. I prefer to think that the native genius took its very inspiration from those things which were borrowed. Something of great power and persistence in any case seems to have survived down to Sassanian times. For Sassanid art has an indefinable character which is identical with that of Achaemenid art. The Persians believed that in the Sassanid kings they had restored the old blood of the ancient dynasties. However true this may be I do not pretend to know. But they had at any rate maintained intact some indefinable quality of power in their art, which is equally discernible in the Achaemenid period. It is not so much a community of style as a perpetuation of quality and manner.

The Persian Exhibition, by bringing together the art of all periods of Persian history, has made it possible for the first time to see what things are continuous and what are occasional in Persian art. The one thing that is certain is that from 500 B.C. to A.D. 500, and perhaps later, Persian art maintained a certain but definite continuity.

South America: (1) Exploring the Map.

By John A. Benn.

The Editor of DISCOVERY *sails this month for South America to attend the Buenos Aires Exhibition. He will make a tour through other parts of the continent, and will travel twenty thousand miles during the next three months. The plans here described include some notes on the chief places to be visited.*

SOUTH AMERICA is very much in the public eye this year on account of the British Empire Trade Exhibition at Buenos Aires. This important Exhibition will be opened on 14th March by the Prince of Wales, who is meanwhile making an extensive tour in other parts of the continent. His Royal Highness first visited Argentina in 1925, and shortly afterwards the British Legation was raised to the status of an Embassy, thus strengthening the friendship that has long been traditional between the two countries. The Exhibition this spring should open yet another chapter in these relations by extending our commerce with South America, which has tended to decline since the war in favour of Germany and the United States. The Prince is showing the keenest interest in the enterprise, and in several recent speeches he has stressed the need for directors of British companies to visit this market and to obtain first-hand information about South American conditions. The publishers of *Discovery* therefore decided to be represented at Buenos Aires, and the writer will sail on 1st February to attend the Exhibition on their behalf.

A Circular Route.

There is a fascination in exploring the maps before a journey, especially when the route will include the Panama Canal and the Andes. It was at first proposed to go direct to Argentina, as the journey through the Canal appeared to involve many extra days at sea. But a chance meeting with Don Agustin Edwards, the Chilean banker, revealed the fact that we could travel by way of New York to Valparaiso and take only one day longer than by the direct route. An opportunity to revisit the United States was too attractive to resist. In 1922 I had received a welcome at Princeton University such as only Americans can give, and the prospect of seeing these friends again makes the larger tour seem less formidable. By crossing the Atlantic on a five-day liner, we shall be able to spend a week on land before sailing for South America.

It happens that our ship, the "Santa Clara," is due to reach the Canal Zone at about the same date as the Atlantic Fleet. It is many years since a section of the Battle Fleet has been sent to these parts. Admiral Sir Michael Hedges, who commands the Fleet, is to visit the Commander-in-Chief of the United States Fleet at Colon, and we shall probably arrive there while these naval exercises are in progress.

The Panama Canal.

Most people assume that the Panama Canal runs east to west, but the map reveals that this is not the case. The isthmus makes a right-angled bend between Colon and Panama City; the canal has been cut through this part of the country and runs almost north and south, the Pacific outlet being east of the Atlantic by twenty-seven miles. This giant waterway is better described as a bridge of water than as a canal in the usual sense, as it comprises a series of locks by which the passing ships are raised before being lowered again at the Pacific end. Traffic through the Canal has greatly increased recently, and during the next few years a new dam will be completed up the Chagres river, to remove a possible shortage of water in very dry weather.

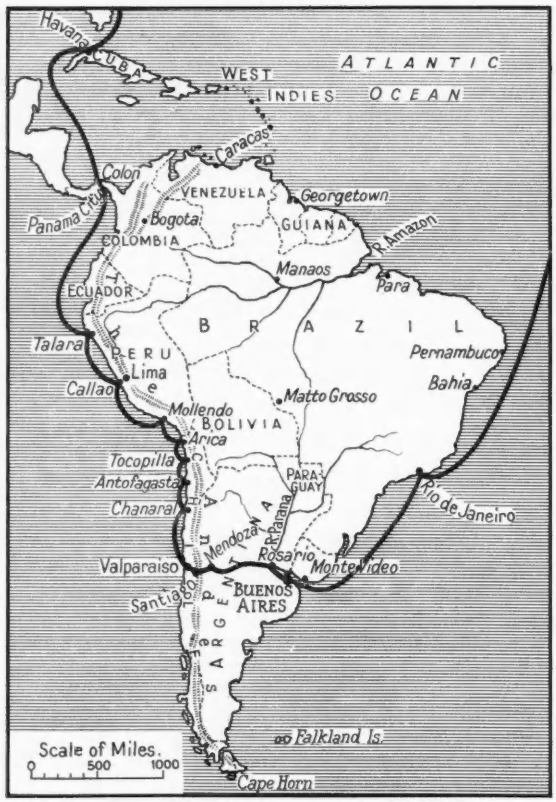
The territory is controlled by the United States and affords a meeting place between the new American and ancient Spanish cultures. In less than twenty-five years it has been converted from a tropical swamp to an efficient and healthy territory. It is even said that if a mosquito is captured in Panama to-day, the finder should send it to a museum! To anticipate impressions of the Canal Zone is, however, impossible, for the contrasts are quite as extraordinary as are to be found anywhere in the world. Indians still live in the forests undisturbed by civilization, while above them the aeroplanes fly in each direction across the isthmus, connecting with services to other parts of South America. The vegetation is essentially tropical, and it is believed that there are more than 2,000 species of flowering plants in this region. Alligators abound in the coastal waters, and the traveller may observe virgin forest at Barro Colorado from the deck of the steamer as it passes through the Canal. This island is preserved as a natural sanctuary where monkeys, pumas, and other

animals still roam in their wild state. It is controlled by the National Research Council of Washington, the work at present being in charge of Dr. James Zetek. Another scientific institution has headquarters in Panama City, near the Pacific end of the Canal, where tropical diseases are studied to commemorate the work of the late Colonel Gorgas.

Like many towns in South America, Panama City is built on the site of an earlier city, and was ransacked more than once by early buccaneers. San José Church contains an altar of gold which is said to have been painted in imitation of wood to save it from pillage.

Our next port of call, Callao, was also sacked in the sixteenth century, by Sir Francis Drake. The steamer stops to allow passengers to visit Lima, the capital of Peru, which is a few miles distant from the coast. Here we shall see the San Marcos University, founded in 1551, and obtain a first glimpse of the Andes, which rise fifty miles behind Lima. Once more the map is deceptive, because of the geographer's practice of assigning a page to each continent irrespective of area. Peru and Chile, which appear but a few hundred miles in extent, have actually four thousand miles of coast-line.

Although the stay in Lima will allow only a few hours to see the city, it should afford an impression of the mixed cultures for which Peru is famous. Remains of the earlier civilizations are still in evidence and ancient ruins jostle modern buildings in the town and its suburbs. It is a matter of regret that our plans will not permit a journey to Cuzco, once the capital of the Inca Empire. Standing 11,000 feet above sea level, this city contains the most remarkable ruins in South America, including the Temple of the Sun, which is believed to be the only building of its kind still in existence. In 1934 there will be an exhibition at Cuzco, showing ancient Incan and Indian art, and illustrating the folk-lore of Peru.



MAP OF THE AUTHOR'S ROUTE IN SOUTH AMERICA.

Our steamer reaches Valparaiso sixteen days after leaving New York. The snow we are likely to have met with at Princeton will have been exchanged at Panama for a tropical heat, and then for the pleasant warmth of the Chilean summer—an unusual contrast in two weeks' travel. Surely nothing will be grander than Valparaiso! To quote the guide book, "the city presents a majestic panorama when viewed from the ocean. An ample circle of hills is backed by the snow-capped peaks of the Cordillera. The terraced slopes are covered far and wide with picturesque dwellings, and when night falls, myriads of lights peep forth over hill and dale and almost vie with the stars." Inevitably the guide book adds that "the view enthralls persons of artistic temperament under nearly any conditions"! (Why *must* guide books comment on their information, nearly always spoiling the impression which even their florid style cannot quite obscure?)

Clearly we must keep an open mind about Valparaiso and pass on to Santiago, from which we shall take train to Los Andes, the terminus of the Chilean Transandine Railway. The line makes a very steep ascent to Caracoles, where it enters the tunnel that takes the train two miles through the top of the mountain range, 13,000 feet above sea level. On the Argentine side the train stops at Puente del Inca, and an excursion may be made to the famous statue of Christ which stands on the frontier at La Cumbra Pass. "Sooner shall these mountains crumble into dust than the peoples of Argentina and Chile break the peace which at the feet of Christ the Redeemer they have sworn to maintain."

On the journey to Buenos Aires from

Mendoza, we shall see the cattle-farms and wheat growing for which Argentina is famous, and shall reach the capital with some useful impressions before attending the Exhibition. A principal object of this important enterprise is to increase the sales of British agricultural machinery; more grain elevators, for example, are much needed just now in Argentina.

Perhaps the biggest trade opportunity is offered by the new era of transport which is about to open with the construction of roads. It would be most appropriate if British engineering and British capital could do something for the country in this direction, comparable with what was done for the railways at the close of the nineteenth century. There are obvious openings for the sale of road-making plant and materials, and an increased demand for motor vehicles of all classes will follow in the near future. The Argentine railways are already anticipating this competition by arranging their own road transport, and they are also considering the establishment of flying services.

AIR VIEW OF PALERMO PARK.

These large grounds near Buenos Aires have been lent by the Argentine Rural Society for the Exhibition, which the Prince of Wales is to open.

The Exhibition will open under most favourable auspices. More than eight hundred British firms are taking part, and the Argentine Rural Society has lent twenty-six acres of ground for the purpose at Palermo Park. Our Government has trebled its original contribution to the enterprise, which was initiated by the British Chamber of Commerce at Buenos Aires. Additional pavilions are being erected to house the motor and aircraft exhibits, as the 20,000 sq. ft. originally allocated has proved insufficient. The big demand in these trades is not surprising, as our Government will stage what is believed to be the largest collection of British aircraft yet shown in any overseas country. The aircraft-carrier *H.M.S. Eagle* will be stationed in Buenos Aires harbour to give demonstration flights. The vessel is widely known as having rescued Señor Franco, the first airman to fly from Europe to South America, and its appearance will be a great attraction.

One important result of the Exhibition is a new interest in Spanish culture, notably in the language. The value of this study for commercial and social reasons was stressed by the Prince of Wales when he addressed the Argentine Club, and delighted the audience by making a speech in Spanish. It will be remembered that His Royal Highness is President of the Anglo-Spanish Institute, which was founded recently to promote closer relations with the Spanish-speaking countries. The director is Sir Charles Bedford, and a series of lectures is now being given in London. A new society has been formed with the same object at Cardiff, the centre of the Welsh tin plate trade. The movement has the support of prominent educationists, and it is hoped to arrange facilities for teaching Spanish in Welsh schools and colleges. A central library will be formed to provide information about Spanish countries. Other organizations are making a close study of these markets. The Federation of British Industries is sending a special representative to South America.

There are many trade openings in other parts of the continent. Brazil, for example, is twice as large as India, and an area four times the size of France enjoys a temperate climate. In a country so abundantly supplied with water power there is a big future for electricity, especially as applied to the railways. Only one important line in Brazil is at present electrified. Another large development is probable in the coastal shipping system.

An opportunity to see something of the life on an estancia at first hand is being afforded to the writer by Lord Luke, who has kindly arrange a week's tour to the Bovril estates at Santa Elena. The journey to Rosario will probably be made by steamer up the Parana river. Finally, it is hoped to spend a week in Rio de Janeiro before leaving for England in April.

To anticipate a journey of 20,000 miles is obviously difficult, and when the actual events are recorded the impressions in this first article may prove to be totally inadequate. But their purpose is merely to outline the tour, which will be described in *Discovery* in later issues this year.

A Rocket to Forecast the Weather.

The use of rockets to discover the conditions of the upper atmosphere has often been proposed but not worked out in detail. Dr. W. J. Humphreys, of the United States Weather Bureau, has now designed an apparatus for this purpose, which he describes in the "Scientific American."

SUPERSTITIONS about the weather are of very ancient date. An interesting example persists to the present day in Bulgaria, where the peasants believe that the golden eagle is a sure protection against hail. With the decline of this bird under modern conditions, the practice has arisen of shooting rockets at the clouds to burst them when a hailstorm threatens. Perhaps this reflects another early tradition, as rockets have been known in China for many centuries. Only in recent years, however, has the rocket been studied as a possible aid to the meteorologist, and an interesting invention for this purpose is just announced from America.

The fascination of rocket flying has attracted many investigators, and previous proposals have been mainly connected with passenger machines or "space ships." The most imaginative writer on this subject, Max Valier, was killed last year while attempting a speed record with his rocket car. About the same time another German inventor succeeded in propelling an aeroplane by rockets, and claimed to have flown about a mile in a test flight near Berlin. These experiments on a small scale were accompanied by research on theoretical problems. Valier, for example, wrote many papers on "space" flying, though he was also sufficiently practical to propose the use of rockets for postal services. It was in *Discovery* that he suggested a trans-Atlantic rocket post, which was the subject of some experiments in the Baltic last summer. The test did not prove very satisfactory, and will be chiefly remembered for the remarkable comments it evoked from the United States authorities. No objection was taken to a rocket post "provided that it would in no way endanger the lives and property of American citizens"!

Solar Radiation.

The latest invention is of more definite value, and is announced by Dr. W. J. Humphreys in the *Scientific American* (January). He explains that the rocket might afford valuable information on questions of great interest to science. For example, we should like to have direct measurements of the intensity of the total solar radiation just outside our atmosphere. Of course, this value can be computed very approximately from measurements made at the surface of the earth, but there are always residual uncertainties owing to the inconstancy of the atmosphere, and to the unknown value of the totally absorbed portion of the ultra-violet. It is to eliminate these uncertainties as far as possible that we need to have a few measurements of the solar constant quite outside any appreciable portion of this atmosphere.

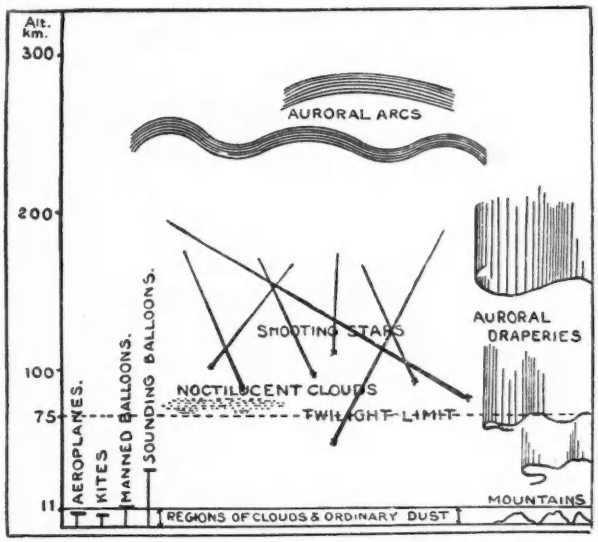
The Upper Air.

The rocket also can give us much information about the upper air. Dr. Humphreys points out that we know very accurately the composition of the atmosphere up to the greatest height reached by clouds (about seven miles in middle latitudes), or throughout the troposphere, the region in which there is constant stirring by vertical convection. At higher levels, however, where vertical convection is either absent or at most quite feeble, the exact composition of the air is unknown and the greater the height the greater this uncertainty. We know that there is much more ozone in the upper atmosphere than there is anywhere below the tops of the highest mountains. We also believe from indirect observations that it is most concentrated about twenty-five miles above the surface. We should greatly like to know just where it does occur and why.

Auroras are nearly all stopped at approximately sixty miles above the earth. Again we ask why, and get no answer. What is the electrical state of the high atmosphere, how does it vary, and how is it maintained? These are all fair questions, but we cannot answer them yet.

What is the temperature of the upper atmosphere? It is known that, on the average, the air gets gradually colder with increase of height, up to about seven miles above sea level where its temperature is approximately −67° F. We know, too, that through the next seven miles at least the temperature is substantially constant with height. But what it is much beyond that height, beyond the levels to which automatic-recording instruments have been carried by sounding balloons, is largely conjecture. It is

true that the strange phenomenon of zones or rings of sound and silence around centres of terrific explosions has led to the conjecture that twenty-five to forty miles above the earth the air is quite as warm as it is at the surface, if not even very much warmer. Many observers hold that the shooting stars, or meteors, strongly support the idea that the very high atmosphere is hot, indeed, it was a study of meteors that first led to that idea. But other conservative scientists have doubts about it and wish for direct observations such as, so far as we now see, only a rocket adequately equipped can supply. Dr. Humphreys explains that obviously the first requirement is to construct a rocket that will attain very great heights — twenty - five miles at least, and if possible 100 miles. The next task will be so to equip the rocket as to secure the information desired. If the rocket is to reach great heights, it seems unlikely that it could carry along unharmed any sort of delicate recording apparatus. It seems practically certain, too, that the unavoidable time-lag (in response to the condition of the air passed through) of any device sturdy enough to withstand the stress upon it due to such a flight, would render every record so obtained wholly worthless. Presumably, therefore, we must try to obtain the desired data with exceedingly simple apparatus. We might obtain samples of the air under known conditions and at known heights and get our information from an examination of them in the laboratory. In any case, we must have these samples if we would know the composition of the air at great altitudes and its change with height, so we might as well obtain them in such manner as to furnish the rest of the desired knowledge. Dr. Humphreys suggests the following method, explaining that it is a mere combination of well-known schemes that work. Let the rocket carry a highly exhausted thin-walled vessel of suitable size surrounded by a mixture of ice and water. This will maintain the vessel at a constant temperature, 32° F. or 0° C., whatever the outside temperature may be. It has been tested under circumstances similar to those proposed here, and it worked. Let this vessel terminate at one end in a drawn-out and sealed-off tube wound at the proper place with a few turns of platinum wire that may be short-circuited to an ample but minute electric cell. Then provide that as the last of the propelling charge leaves the rocket (at the moment when the rocket has reached its greatest height and is moving slowest) the tip of the glass tube shall be broken, admitting air to the exhausted vessel, and at the same time the wire shall be short-circuited so as to seal the tube again with its sample of air.



WHERE THE ROCKET WOULD HELP.

The existing sources of meteorological information are indicated in this diagram, reproduced from "Physics of the Air," by courtesy of the McGraw-Hill Book Co. The rocket would greatly help in exploring regions outside the reach of balloons.

We have now secured a sample of the upper air at a known temperature, not the temperature it had before being captured, but that of the walls of the containing vessel, 0° C., to which it necessarily came immediately on admission and before being sealed in. The little vessel containing this sample of air is eased back to earth by means of a suitable parachute, and further protected from injury on landing by a shock-absorbing device—all these being old tricks familiar to scientists.

In the laboratory, the capture tube with its sample of upper air could be brought to the temperature it had when filled, 0° C., and the pressure quite accurately determined at which this air just fills the tube at that temperature. This obviously would be the pressure of the atmosphere at the time and level of filling. The sample could then be analysed, and thus the composition of the free air at the level in question determined to any reasonable degree of accuracy.

Thus far well and good, but one important factor still is missing, namely, the height at which the sample was obtained. On very clear days the rocket might perhaps be followed by two theodolities some distance apart, the pointing of each noted at the time of filling —that is, when the rocket ceased to discharge, or

when at its maximum altitude—and the actual height then calculated from these theodolite readings by simple triangulation, just as the heights of pilot balloons have frequently been determined. Again, if the propelling discharge is luminous (it could be made so), the rocket could be followed and its height at the time of filling similarly determined by theodolities on cloudless dark nights. Finally, a bright flash might be produced on the rocket at the time of sampling, and this flash photographed on suitable nights from two stations, the height of the flash being determined from the positions of its images on the two photographs among the star images obtained at the same time. This is the simple " parallax method " used for finding the heights of the auroras.

We now have, let us suppose, the exact composition of the atmosphere and its pressure at numerous different known heights up to, say, fifty miles above sea level. From these data in turn we can readily compute the temperature distribution, for there is just one distribution of temperature that can give the observed pressures with the particular gases in question and at the specified heights.

Dr. Humphreys concludes his article in the *Scientific American* by discussing the practical applications of this new knowledge. It might be used to great advantage in weather forecasting, for there is evidence that some least-expected general storms originate from conditions in the upper atmosphere, conditions of which only the rocket can inform us in time for our forecasts. We may possibly discover that this upper air is the ideal medium in which to fly, especially on long trips. It is wholly free from the ice hazard, from all danger of lightning and from " bumps " of every kind. Flying in it should be perfect, for there are never clouds to blot out the sun by day or hide the stars at night. But before we can fly in this region to best advantage we must know more about it.

Rockets to Replace Kites.

In addition to its use in the study of the upper air and of the sun and its radiation, there is one practical need in sight—indeed, upon us—for the rocket in the lower atmosphere. That need is for it to take the place of the kite in getting the temperature, pressure and humidity of the free air through the first two or three miles above the surface—information of great importance in weather forecasting. Kites cannot be flown every day, and when they are flown it takes a good while to get them up and back again ; they are also being rendered obsolete by the aeroplane. A kite wire is too great a hazard to the aviator to be tolerated where there is much flying. Of course, an aeroplane can be sent up for the sort of information that is obtained by kites, and some are used for that purpose, but it seems practically certain that the desired data could be obtained with a rocket (letting the recording instruments down slowly with a parachute) much more quickly and at less cost. This is one immediate application of the rocket well worth trying out fully and thoroughly.

Now and again the meteorologist is " up against it," as we say. The surface conditions may leave him wholly in doubt as to whether there will be local showers, for example, and yet the public insists on being told. For the moment this is discouraging, but there is buoyant hope in the fact that in most such cases the sounding of the air to the height of only two or three miles would change perplexing doubts to reasonable assurances. Occasionally, disturbances even of greater extent could be clearly indicated hours before any definite surface evidence of their approach is available. We need the weather rocket for these practical purposes, and in Dr. Humphreys' opinion it should not be long before the invention is put into use.

Fuel Problems.

Several questions raised above are discussed in a paper on the " Principles of Rocket Propulsion," read at Shanghai by Dr. Herbert Chatley, M.Inst.C.E., who has sent a copy to *Discovery*. He points out that in rockets the propellant material is wholly carried in the apparatus, which is therefore independent of the air for its action, whereas most other forms of heat engine require an air supply. This feature is a necessity in super-aerial flight, but is a disadvantage in ordinary flight since it involves the transportation of much additional fuel material. Contrary to popular belief, the energy in explosives is not much greater than in fuels. To give a simple example of the extra weight involved, petrol requires four times its weight in pure oxygen or twenty times its weight of ordinary air to produce complete combustion. The duration of the propulsive effort can only be comparatively short, since the rate of combustion is high. Ten minutes has been indicated as a probable limit for the time.

Dr. Chatley states that the ejected stream of gas which causes propulsion can, under favourable conditions, have a very high velocity—as much as 8,000 feet per second has actually been obtained in some of Professor Goddard's experiments ; hence a large recoil effect is obtainable with a comparatively small amount of ejected material. It will be found that if one pound of gas is ejected per second in a

parallel stream with a velocity of 8,000 feet per second, the recoil force is 250 pounds.

Unless, however, the forward velocity of the rocket is exactly equal to the backward velocity of ejection relative to the rocket, there is the disadvantage that energy is wasted in the kinetic energy of the ejected material. If the rocket is moving forward with a velocity of 100 feet per second (about seventy miles per hour) and the ejection velocity is 8,000 feet per second, the work done on the rocket per pound of ejected material is 25,000 foot-pounds per second, but the energy carried away in the ejected stream is 975,000 foot-pounds per second, so that the efficiency of propulsion is only 2½ per cent.

In the air a very high rocket velocity implies great air resistance, and in any case presupposes an earlier acceleration of great magnitude or long duration.

With regard to propulsive power, the energy of a combustible mixture which can be wholly converted to gas is, in the case of ordinary high explosives, about 1,000 calories per gram, and about 3,500 calories per gram for a 1 to 8 hydrogen-oxygen mixture. Using the lower value it appears that one pound of such explosive could lift *itself* under ideal conditions to a height of 1,400,000 feet or about 260 miles. If the combustion were controlled and the recoil applied steadily to the diminishing mass, it is conceivable that a small fraction of the mass might be given a vertical velocity of as much as seven miles a second, in which case the kinetic energy is enough to neutralize the earth's attraction. This is the basis of the dreams of a rocket flight to the moon.

Some Comparisons.

In a note on the atmosphere, Dr. Chatley compares existing methods of observation with the proposed rocket. Aeroplanes have reached heights of nearly eight miles, at which the density is only 20 per cent that at sea level. Rubber sounding balloons have reached twenty miles, at which height the pressure (or density) is only about 2 per cent that on earth. The top of the trajectory of the "Big Bertha" was about this same height. Meteorites (with speeds of twenty miles per second) commence to glow at heights estimated in some cases to be over 200 kilometres. Broadly speaking, we can say that the atmosphere reduces to about 1 per cent at a height of twenty-two miles and is practically non-existent at 250 miles. At great heights the proportion of nitrogen in the air increases, the oxygen and argon decrease, and possibly traces of hydrogen and helium occur.

At low levels, the resistance of the atmosphere at the prodigious speeds spoken of is enormous.

Progress at Ur.

THE joint expedition of the British Museum and the Museum of the University of Pennsylvania, under the leadership of Mr. Woolley, has opened the new season's work at Ur with a remarkable discovery—the tombs of the great kings of the Third Dynasty, dating from about 2400 B.C. This was the kingdom's great age of prosperity, and its kings, Ur-Engur, Dungi and Bur-Sin, were famous figures in history. A brick building, bearing the name of Bur-Sin, had been unearthed at the end of the previous season. On further investigation, this proved to be an annexe built by that monarch to a much larger building, a temple of his father King Dungi. Below the floors of both are tombs—large and lofty chambers with corbel vaults, which were unquestionably the tombs of the kings. Dungi's tomb contains a high platform from which flights of stairs descend to chambers or passages, the exploration of which is not completed. Unfortunately, all the buildings were completely plundered when Ur fell a victim to the Elamite invaders. Structurally, they are of great interest, however, and the possibilities of the site are not yet exhausted.

The character of the buildings surpasses all expectations. On the south rampart of the city the excavators have completed the clearing of the temple recently discovered. It is a twin temple consecrated to the cult of two little-known gods, and it has been possible to trace its vicissitudes through a history lasting from at least as early as 2200 down to the time of Nebuchadnezzar in the sixth century before Christ. The former is the probable date of the earliest halls, but a monument was found dedicated by King Naran-Sin, who reigned 350 years earlier.

The discovery of the great palace was completely new; it was built by Nebonidus in 550 B.C. for his daughter, Belshazzar's sister, whom he made High Priestess of the Moon God at Ur. It is a large and complicated building in mud brick, about a hundred yards square and containing over seventy rooms and courts. In one of the principal doorways, under the brick pavement, there were brick boxes containing the humble emblems of those powers who protect a house, and among them was the God Papsugal, a squat and ugly figure, girt with a copper baldric and brandishing a copper spear. Little mud dogs, in sets of five, are painted in different colours; cracked and crumbling, they were still keeping guard, and although the walls of the palace had been destroyed down to the floor level, the foundations had been preserved to show in what manner of building the Princess kept her state.

Animals our Children will not See.

By Major R. W. G. Hingston.

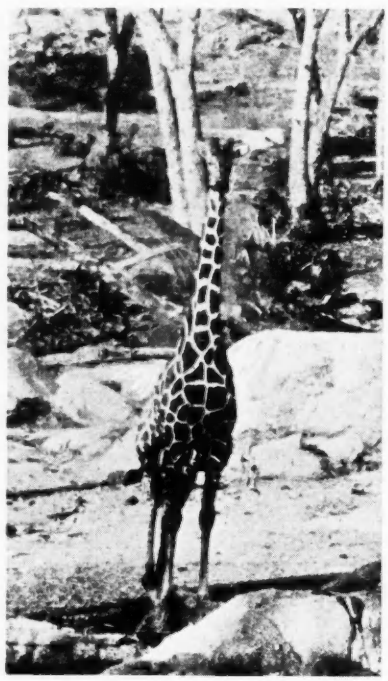
In view of the trouble and expense which is devoted to preserving the remains of extinct animals, it is odd to reflect how little effort is being made to check the ruthless extermination of many rare species. The author reminds us that even such familiar animals as the elephant, the giraffe and the zebra are likely to share the fate of the dodo and the quagga, unless national parks are set aside as sanctuaries for them.

It is a melancholy thought that future generations will not enjoy some of the wonderful things which we have inherited from those who preceded us. Yet this will certainly be the case so far as the wild life of the British Empire is concerned. Extermination has proceeded unchecked in the past, it is going on to-day, and so far as we can see will continue still more rapidly in the future.

Our grandparents saw in the wild state a number of creatures which we know only from specimens and illustrations. Admittedly, they could not have seen the dodo, for it was exterminated by sailors in about 1691. Our knowledge of it is confined to a few stuffed relics and some bones dug up in Mauritius. But they might easily have known the South African bluebuck, which did not vanish until 1800. All we have of it now is eight skins scattered through the museums of Europe. Our parents, had they been adventurous skin-dealers, might have traded in the quagga of Cape Colony and Natal. This animal vanished about fifty years ago, and only eighteen skins remain. They could certainly have enriched themselves on the bison herds of America. It was only fifty years ago that the great crime of the bison was perpetrated, when four million of these beasts were foolishly slaughtered and not one fiftieth part of the meat used.

Our grandparents might have met with the great auk on the North Atlantic seaboard, where its communities were too vast to be numbered. This magnificent bird persisted until ninety years ago, but a few skins and some odd egg shells are all that is now left. They certainly could have witnessed the passenger pigeon flights that once blackened the skies of the United States. Fifty-four years ago the flights were so dense that they filled the air for five or six miles, but to-day there is not a single pigeon throughout the whole of North America. We ourselves, in our childhood, might have seen much that is now lost for ever. We could have seen the Manchurian stag in China; there were two hundred left in 1900, but these the Boxer soldiers annihilated. In Asia, the species is now totally extinct, although a small semi-domesticated herd is still in the possession of the Duke of Bedford. Certainly we might have seen the schools of Arctic whales before they had been totally decimated by whalers.

It is often thought that this ruthless annihilation is ending. We take such trouble and go to so much expense to preserve in our museums the dead bones of the world; surely we must be making some little effort to conserve the irreplaceable living thing? But extinction is going on by leaps and bounds, and is probably advancing every year at an increasing pace. As we condemn the colonists of America for wiping the bison out of their country, so will future generations, with greater reason, more emphatically condemn us.



THREATENED WITH EXTINCTION.

The giraffe is fast disappearing, owing to the pressure of trade and the spread of human settlement and cultivation.

Let us see what we have done with the European bison, the finest creature in our continental fauna. It is only within the last ten years that it has vanished. It inhabited south-west Russia and the Caucasus Mountains, but to-day is extinct in the wild state. It was annihilated during or just after the war. A few specimens still

remain in captivity, but it is only a matter of some years before these will also become extinct. In spite of all the private effort made to conserve wild life, we see the most notable animal in our own continent obliterated under our very eyes. When we fail to preserve the best in our own continent, how can we rely on any creature's survival in the uncontrolled tracts of Africa and Asia?

Several other animals are about to share the fate of the European bison. Some will vanish within our own lifetime; others will be known to our children and grandchildren only through pictures and museum skins. And the saddest thing about this prospect is that the creatures marching to extinction are the most remarkable in the world of life. An example is found in the Javan rhinoceros. If any still remain, which is doubtful, they are hidden in the depths of the Malay forests beyond the reach of the trader in horns. The Chinese place an imaginary value on the horn, believing that a drug can be made from it capable of exciting the passions. Yet this extraordinary beast—a remnant, as it were, of the prehistoric creation—is being obliterated from the face of the earth in order to satisfy this depraved quackery. The same thing has occurred in Africa. The white rhinoceros once covered a large area of the continent. The disreputable trade went on gaily, and only two small communities now remain—one of about thirty specimens in Zululand and another of about two hundred along the upper reaches of the Nile. It cannot be long before the white rhinoceros will go the way of all wild flesh.

GREVY'S ZEBRA.

This species is becoming increasingly rare, and unless we make serious efforts to keep it, writes the author, we must watch it diminish and finally disappear.

It is doubtful if our children will see Grevy's zebra. Burchell's zebra has gone; its near relative the quagga has gone, and now comes the turn for Grevy's zebra. It lives in the mountains north of Victoria Nyanza. It is rare and very limited in distribution, and unless we make serious efforts to keep it, we must watch it diminish and finally disappear. Will our children see the nyala? It is one of the few forest-frequenting antelopes, and there cannot be many hundreds left in the jungles of Zululand and southern Nyasaland. Unless they are preserved with the utmost care, they too will vanish from the earth. I doubt if the black rhinoceros will long survive, or the sable or the eland or the kudu. Will our grandchildren see the African elephant? Not unless some restriction is placed on the enormous trade in ivory.

People naturally ask, What causes extinction? Why should animals be annihilated to the last individual? The two causes are trade and cultivation. It was trade in hides that obliterated the quagga and swept the animal herds from South Africa. In America, trade pressed so hard on the bison that the skins were often removed from only one side of the animals, it being more profitable to shoot others than to turn the dead beasts over. It was trade in oil that swept the whales from the Arctic and which is to-day doing the same in the Antarctic. Trade in feathers exterminated the great auk. Stone pens were erected; the birds were driven into them like sheep, slain in millions and the bodies left to rot. Wild life has amazing recuperative powers. It can easily recover from the activities of sportsmen, who are usually content with a few good trophies and discriminate in that they shoot only the males. But it cannot contend against the pressure of a method of trade which is wholesale, ruthless and indiscriminating.

The second cause, and by a long way second, is the spread of human settlement and cultivation. This is an important contributory cause. It eliminates the wild life over some particular area, though it is doubtful if human settlement in itself has ever wiped a species completely off the earth. The effect of this cause is well exemplified in Africa. Human settlement is everywhere spreading through the continent, more land is being taken from the wilderness, and each step forward in this direction brings man up against the wild life. The elephant tramples and devours his plantations, the buffalo destroys his maize, the hippopotamus his rice, the eland his cotton, the pigs and baboons destroy everything he grows. The wild beasts are the settler's incessant enemy, and in his efforts to subdue the desert this enemy has to go to the wall. Wherever in Africa a settlement springs up, the wild life must necessarily disappear in its vicinity.

What then can be done? Trade goes on, and there seems no possibility of checking its progress. The amount of ivory and furs disposed of yearly makes a figure that is absolutely staggering. Not a single animal that is subject to trade can be regarded as safe from extinction. The African elephant is slain for its tusks, the rhinoceros for its horns, the hippopotamus for its teeth; unless some check can be put on their destruction, these three beasts, the most extraordinary products of creation, will join the animals of history and legend.

Cultivation and settlement also proceed apace. In Africa they are spreading far and wide and the wild life is being pushed further afield. Its strongholds are shrinking with alarming rapidity. Every invention that facilitates travel or improves the accuracy of lethal weapons adds its effect to animal extermination. Twenty years ago a shooting expedition in Africa was a slow and fatiguing business. To-day it is a delightful motor-car picnic. The car will bring the sportsman to his shooting ground, carry all his camp equipment, put him within range of the desired animal, and, if desired, the heads may be collected without ever leaving the vehicle. The modern rifle will bring success even to the most inexperienced novice. The wild life of Africa is going steadily down against this combination of hostile forces. Nor does it seem possible to put any real check on them unless public feeling comes to the rescue. Trade, settlement and sport will continue, and it is certain that, if nothing be done, the wild life will in the end vanish before them.

VICTIMS OF THE IVORY TRADE.

Will our grandchildren see the African elephant? Its days are numbered unless a rigid restriction is immediately placed upon the enormous trade in ivory.

There is only one chance: a fragment of the wild life can be saved for posterity by the creation of permanent sanctuaries. Nothing else can do it. The right and natural spread of human settlement must not be checked; one would break the ruthlessness of the destructive type of trade if one could, but its interests are too powerful. One must retreat before these forces and try to find safety behind some barrier. The wild life must be separated from all human activity and placed in a special compartment of its own. So long as man and animals are kept together, wild life will be driven to the wall. Separate compartments are the only solution. But if this policy is to be successful the animal compartment must be absolutely inviolable and set aside for all time as a sanctuary for animal life. The Game Reserves, as at present existing in Africa, fall very far short of what is essential. These reserves are temporary sanctuaries only, located in waste places, and lasting only as long as nothing claims them for some other use. But they hold no title and can be abolished with ease. From time to time they disappear and new ones take their place; they are far too unstable and shifting in character to offer lasting security for wild life.

What is wanted in Africa, and all through the Empire, are National Parks on a stable basis. A final decision should be arrived at as to what area of land in each country can be set aside for wild life conservation. It should then be made by Act of Parliament the permanent property of the public. Title and permanency are absolutely necessary; otherwise the sanctuary will be only a makeshift and cannot effectually meet the case. The position in Africa is particularly urgent, as the wild life is there diminishing rapidly. A National Park is required in northern Rhodesia in order to shelter a typical sample of the wild species of south-east Africa. Parks are needed in Kenya and Tanganyika to preserve something of that abundance and variety which characterize the plains game of these territories. Then the tops of the equatorial mountains in Africa, especially Kilimanjaro above the lower forest belt, need protection not only on account of their fauna but because of their profusion of vegetable life which is as wonderful as it is unique.

The elephant, so harassed because of its ivory, requires the urgent protection of a sanctuary. The gorilla, which enters the south-west corner of Uganda, requires its whole area of distribution protected on this special status. Parks are necessary also in West Africa and India, and indeed wherever the large mammals are being pushed slowly out of the world.

Sportsmen, naturalists and lovers of nature all should join to save for future generations some fragment of what they have enjoyed themselves.

Book Reviews.

Comets. By CHARLES P. OLIVIER. (Ballière, Tindall & Cox. 16*s.*).

The author of this book is Professor of Astronomy in the University of Pennsylvania, and Director of the Flower Observatory. He is also the leading meteoric observer in the United States, and his work on meteors is the recognized text-book on the subject. Meteors and comets are closely allied, and it is not surprising that he now publishes a sister volume on comets. The work assumes no previous technical knowledge, and is written in a pleasant and readable style; chapter xiv, "Collisions of Comets with the Earth," is, in fact, quite thrilling. It describes the great meteor fall in Siberia in 1908, and the still more stupendous fall that caused the great pit called "Meteor Crater" in Arizona many centuries ago. The Siberian fall occurred in such a thinly inhabited neighbourhood that it did not become generally known until three years ago, when Professor Kulik made a scientific exploration of the regions. For miles around the forest had been levelled by the mighty blast accompanying the meteor; thousands of reindeer were killed. Peasants at some distance were thrown down and felt scorching heat. There were numerous shell-holes; one was fifty yards in diameter where the meteor struck the ground. Kulik estimated the total mass that fell as at least forty thousand tons.

From careful study of the two comets that approached so near to the earth in June, 1927, and June, 1930, M. Baldet considers that the nucleus of a comet is probably a solid lump about a quarter of a mile in diameter, so that impact of one with the earth would be a more serious matter than has sometimes been stated. Fortunately such events are extremely rare. Dr. Olivier was at the Lick observatory for the return of Halley's comet in 1910, and gives a full account of the interesting developments that were observed there. He quotes Orloff's estimate of the mass of the nucleus; he made the least possible value thirty million tons. Earlier writers were much in error in suggesting that the whole mass of a comet could be put into a portmanteau.

In the reviewer's opinion, Dr. Olivier has followed Professor H. N. Russell too hastily in writing on page 49, "ruling out, therefore, the families of Saturn, Uranus and Neptune as being probably only apparent, we are left with the large and growing family of Jupiter alone to consider." As against this, the connexion of the comet of the November meteors with Uranus is almost universally admitted, and there is a group of nine comets with periods between sixty and eighty years, and aphelia near the orbit of Neptune. No comets are known with periods coming within some thirty years of these on either side. The fact that these comets do not now make very near approaches to Neptune is quite sufficiently explained by the powerful disturbing action of Jupiter and Saturn. In fact, Dr. Olivier himself invokes the aid of Uranus and Neptune on page 230. He supposes that comets were the result of matter expelled from higher latitudes of the sun at the time of the approach of another sun, which is supposed to have caused the expulsion of the matter forming the planets. The cometary matter is presumed to have revolved in orbits with large perihelion distances (thirty units, the distance of Neptune from the sun, is one of the values suggested) thus being preserved from disruptive action until recent times, when planetary perturbations are supposed to have altered the orbits. Obviously, Uranus and Neptune are the only planets that would be effective at such distances.

There is an explanation at the end of the book of the terms used in defining the orbits of comets and the methods by which their motion may be predicted. It is as well to point out that Dr. Olivier is not following ordinary usage in defining the Epoch as the date of passing perihelion, and that Gale's comet of 1927, which is taken as a type of parabolic motion, is really moving in an ellipse with a period of eleven years. Pons-Winnecke's comet claims a chapter to itself. The author was one of the first to detect that the meteor shower of June 28, 1916, was connected with this comet. Mr. Denning came simultaneously to the same conclusion in England. In June 1927, this comet made the second closest approach to the earth on record, giving special opportunities for studying it in detail. Lexell's comet had approached still closer in 1770, but this was not known until afterwards, nor were there many good telescopes available at that time. The suggestion is made in this book that the great Siberian meteor of 1908 may not improbably have been a fragment separated from this comet some time in the past.

Dr. Olivier explains in the preface that he has designed the book as a sequel to such works as Chambers' *Story of the Comets.* This being so, one feels that a little space should have been given to several interesting comets discovered since the publication of Chambers' book in 1910; we would instance in particular Skjellerup's brilliant daylight comet of 1927; Skjellerup's comet of 1922, which Dr. Merton, by a difficult computation of pertubations, proved to be identical with Grigg's of 1902; the comet found by Drs. Schwassmann and Wachmann in 1927, whose orbit lies wholly between those of Jupiter and Saturn; (incidentally, this renders out-of-date the statement on page 230 of the book that we know no perihelion distances greater than five); and the comet found by Forbes in 1928, which proved to be identical with comets seen in 1818 and 1873. But though some improvements in the book are possible, it is one which all who are interested in comets should procure. They can hardly fail to find much in it that is new to them. There are several good photographic illustrations, including one of a brilliant fireball, seen in France in 1928.

The Bronze Age. By V. GORDON CHILDE. (Cambridge University Press. 8*s.* 6*d.*).

The author has written an extremely useful book on the Bronze Age—the vast and somewhat indeterminate period in man's progress between the Stone Age and the Iron Age. Now that prehistory, once the sport of a few enthusiasts, has become a serious and popular study in every civilized country, an orderly presentation of the facts, such as Professor Childe gives about the Bronze Age, is much needed. For the rapid development of the subject is tending to cause confusion. The excavators are busy in every part of the globe and are publishing their results in scores of learned periodicals. Scholars in various countries are trying, on the basis of archaeological finds, to distinguish the several culture periods in the dim past of these countries. Unfortunately, each expert seems to have his own method of nomenclature, so that it is difficult to relate the discoveries made in one region to those made in another, and to form any general conception of prehistoric Europe in a given period. Italy, South Germany, Hungary, Portugal, Scandinavia, has each its own system for mapping out the Bronze Age, and the beginner is soon lost in the maze of cultures

represented by arbitrary designations, such as Villanovan, Lausitz, or El Argar—to name a few among many. Now comes the author of this book to reduce this chaos to some sort of order, and to present a broad survey of the Bronze Age in three periods, Early, Middle and Late. First of all, he sums up what is known about metal-working and trade; then he describes, with useful sketches, the common types of weapons and tools that have been found in various regions. Finally, after his historic account of the periods, he deals cautiously with the controversial and still obscure problem of the races whose work in bronze has been preserved.

One important fact which is rightly stressed is that civilization in the Bronze Age, as in other periods of the world's history, was not uniform throughout all regions. Europe, it is clear, was ages behind Egypt and Mesopotamia, the Iranian plateau and Northern India. Bronze was worked in Egypt before 3,000 B.C., but its introduction into Europe was at least a thousand years later. Iron superseded bronze in the Aegean round about 1250 B.C., but the inhabitants of Britain were still bronze users in 400 B.C. "A single tomb in the acropolis of Mycenae contained more gold than has been collected from thousands of British barrows ranging over fifteen hundred years. And the Mycenaean tombs were poverty-stricken in comparison with the Royal Graves at Ur that are fifteen hundred years earlier." Our archaeologists have thus to be humble. In the prehistoric period, Europe north of the Alps was sparsely populated by savage tribes, whose relics are curious rather than beautiful. For all that, the study of these homely beginnings of European civilization is intensely fascinating, and this book will be found invaluable by the increasing number of people who care for the past of our race.

A Flight from Cairo to Capetown and Back. By AIR-COMMODORE C. R. SAMSON. (Ernest Benn. 15*s*.).

In the spring of 1927 Air-Commodore Samson, commanding a R.A.F. unit of four Fairey planes, made a service flight from Cairo to Capetown and back. His flying time for a journey of about 17,000 miles was 160 hours, and the party had no mishaps, though one officer had to be left behind in a South African hospital. South African airmen met them in Uganda and escorted them south. In this admirable book the author describes the tour so simply and clearly that one seems to share with him a bird's-eye view of Africa in all its variety. The seeming uneventfulness of the narration is deceptive. The careful reader, who makes allowance for Air-Commodore Samson's habit of minimizing difficulties, will note that he and his fellow-pilots needed all their skill and daring in dealing with sandstorms and the air pockets common over tropical lands and in flying over lofty mountains enshrouded in cloud. Coming south from Tanganyika into Northern Rhodesia, the author "had a bit of luck, as just as it seemed I would have to go through clouds for some time I saw a little archway of blue sky with a portion of the crest of the escarpment clearly defined. I dived for it and all five of us flew through a little clear tunnel which was about 300 feet above the ground and about 100 yards wide." He had a still worse experience in skirting the South African coast eastward from Capetown. "At Riversdale, which is a very pretty little spot, I altered course and made for the mountains once more. They didn't provide an inviting view, as the tops were in the clouds, but once more my luck was in, as a polite cloud suddenly lifted and provided a small clear archway above the razor-edge of the ridge. There was just room for an aeroplane to pass through, and we took it in a single line ahead, three or four feet above the hill-tops."

On the return journey, south of Khartum, the airmen suddenly ran into a dust storm. "I experienced one of the worst moments of my flying life when, to my horror, I realized that one of them (his companions) was right across my bows. I dived vertically, and it was only by the grace of the Lord that a collision was averted. It was a close call, and as I was flying only about fifty feet above the ground I don't know to this day how I both got underneath and escaped hitting the ground. The incident shook me." In the very last minute of the flight, as the author was circling the aerodrome at Heliopolis, his engine stopped dead—but happily restarted before anything happened. The Air-Commodore does not stress any of these narrow escapes, but relates them and passes on. While flying over the vast and dreary swamps of the Upper Nile, he speculated on the probable fate of an airman whose machine failed him just there, remote from human aid. But he is a cheerful optimist by nature, and it must be admitted that even the narrow shaves were extremely few, and that the machines gave no trouble at all because they were properly cared for.

Rightly considered, the lack of thrills is the most memorable feature of the book. Even three and a half years ago, the north-to-south air route through Africa was sufficiently well equipped with aerodromes to be reasonably safe. There should thus be a good prospect of success for Imperial Airways Ltd., which is starting a regular passenger service to Capetown. Would-be travellers will find the book, with its numerous illustrations and map, an excellent guide to the regions over which they will pass, just as their pilots will delight in the Air-Commodore's practical hints as to landmarks and aerodromes. The ordinary reader, who cannot take such flights, must be grateful for so lively a narrative of the journey. A generation ago Cecil Rhodes was dreaming of the "All-Red Route" from the Cape to Cairo, which is now a reality, with British stations at intervals amid peaceful native populations and a thriving copper mining industry in Northern Rhodesia, where the most modern machinery is worked with native labour. To middle-aged people who look back, the developments in Africa which Air-Commodore Samson notes and takes for granted, must seem almost like a fairy-tale, so thoroughly has the "Dark Continent" been awakened.

The Case for the Sea Serpent. By R. T. GOULD. (Philip Alan. 12*s*. 6*d*.).

The author of "Enigmas" again attempts an explanation of the inexplicable, and here examines the case for the sea serpent. He suggests that, when the evidence is examined in detail, one cannot fail to be impressed by its consistent and weighty character in favour of the serpent, nor with the almost puerile nature of the attempts to discredit it by supplying some naturalistic explanation. The author gives ample opportunity of studying the evidence in detail, but it may, perhaps, be found a trifle too "consistent and weighty." He has selected thirty eye-witnesses' accounts, and the text of each report is given at great length from its original source. Two hundred pages are devoted to the evidence, and, since many of the reports are almost identical, this part of the book becomes somewhat tedious. The most interesting chapter occupies only two pages; it contains the author's own conclusions. He suggests that the available evidence amply demonstrates the existence of more than one type of sea creature not yet

scientifically described. There are grounds, he thinks, for believing in three such animals : a long-necked seal, a gigantic turtle-like creature, and a species larger than either of these and resembling in outline the Plesiosaurus of Mesozoic times. In each case, the animal has much the same characteristics : a slender neck and tail and a comparatively large body with propelling flippers. Its colour is dark brown above and lighter below ; its skin is smooth, and some species possess a mane.

The first report was published in 1734, but a more recent occasion on which a sea serpent was observed was in the spring of 1917, when the animal was seen by the captain of the *Hilary*. According to his report, its head was the shape of a cow's, although it was somewhat larger and had no ears or horns. From the back of the head to the dorsal fin, no part of the creature was visible above water, but the top of the neck was just level with the surface, and its snake-like movements were clearly seen. The fin appeared to be like a black triangle and was very thin and flabby. Its height was estimated to be about four feet when highest out of the water. The length of the neck was considered to be not less than twenty feet, and the total length of the creature was about sixty feet. The animal lifted its head once or twice as the ship approached, and the captain was impressed by the invisibility of mouth, eyes and ears. From these observations, the author is convinced that the creature was neither a shark nor a whale, since each would be incapable of lifting its head while keeping its neck flush with the water. Yet its computed length precludes the supposition that it was a ribbon fish. There seems to be no doubt, he thinks, that the observers saw a living creature of unknown species.

The book is written in an engaging, if somewhat chatty style, and the author is to be complimented on his meticulous care in verifying every detail in the evidence quoted. The text of each report is given from its original source, many of which must have proved not readily accessible. But it is difficult to escape the impression that the subject itself is thin, and hardly merits the careful attention given it. Commander Gould might, perhaps, have done better to have included a chapter on the sea serpent in his previous book, " Enigmas," and to have given the evidence in considerably less detail. To devote nearly three hundred pages to the subject seems to be rather extravagant, and since no really satisfying conclusions are arrived at, the sea serpent remains an enigma after all. The author has not yet discarded the irritating habit of footnotes, of which the book contains some hundreds. An otherwise effective wrapper design is quite spoiled by untidy hand printing.

How Insects Fly. By R. E. SNODGRASS. (Smithsonian Institution, Washington.)

Although man has never been successful in equipping himself with wings, and has given up hope of acquiring them, he has succeeded in building machines that will fly, and whether his craft is lighter or heavier than air, its driving mechanism is a set of rotating blades, the nearest counterparts of which in the animal world are the wings of certain insects. The origin and construction of insects' wings, their structure and muscular arrangement, are described in this booklet, the author of which is a member of the Bureau of Entomology, United States Department of Agriculture.

There is an interesting chapter on the insect's manner of flight. It is not surprising that insects should be experts on the wing, considering that they have been flying for several hundred million years. But we are inclined to marvel when we see them perform feats that are as yet quite impossible for our newly developed, heavier-than-air machines. In addition to their ability to steer themselves adroitly in forward flight, many insects can reverse gear and fly directly backwards without altering the position of their bodies. Moreover, they have some mechanism of adjustment by which they can fly sideways, at right angles to the body axis. The author explains that the dragon flies are particularly adept in these modes of flight, but many of the smaller insects, such as the flies and bees, are quite equal to the dragon flies in being able to dart suddenly to the side or rearwards while the head still points in the direction of the arrested forward flight. Reversed and lateral flying is probably controlled also by the pleural muscles of the flight mechanism, which alone can give an altered or differential action to the wings ; but it is remarkable that organs so evidently fashioned for forward flight, as are the wings of insects, can function efficiently for producing motion in other directions.

The report describes some experiments on the effect of wing movements on the surrounding air, which were made by Mr. Demoll. By means of a simple apparatus consisting of a frame with several horizontal cross bars on which were suspended rows of fine owl feathers, he was able to demonstrate the direction of the air currents created by the wings in vibration when the insect itself is held stationary. The lightness of the feathers made the latter delicately responsive to any disturbance of the air in their immediate vicinity. Experiments with various insects showed that the air drawn towards the stationary body comes from all directions. The oncoming currents are, however, turned to the rear of the body, which is therefore carried forward in flight.

The Film Till Now. By PAUL ROTHA. (Jonathan Cape. 15*s*.).

Film enthusiasts are divided into two groups, the intelligentsia who only concede the name of film to those which come from Russia and a few from France ; and the " fans " who do not care where a film comes from or what it is about as long as their particular star is in it. No one will deny Mr. Rotha the right to be called a film enthusiast, and it is obvious that the film which most appeals to him, personally, is the type which interests the intelligentsia. But Mr. Rotha, unlike the intelligentsia, does not stop there : he does not blindly turn from everything which hails from Hollywood or Elstree.

The publishers claim that " The Film Till Now " is the most comprehensive work on films yet published in English, and the claim is a just one. There seems to be no nook or cranny of the film industry into which Mr. Rotha has not pried. For the early part of his book he has covered the same country as Mr. Messel in " This Film Business," and he is not so comprehensive on the origin and early years of this interesting infant. However, Mr. Messel wrote in 1928, and the " now " of Mr. Rotha's title is 1930, a very different matter. The talking picture has intervened, the silent film is history, technique is in the melting pot, and the industry virtually at the beginning once more.

The advance guard—once revolutionary, now quite definitely reactionary—with ashes on their heads foretell the " downfall " of the film unless the clock is put back and celluloid consents to hold its tongue. Mr. Rotha does not take so gloomy a view of the situation ; he diagnoses this ailment as a minor one which will shortly pass. But will it ? Surely so sturdy an infant as the cinematograph, having taught itself to walk is not going to die because it finds it has a tongue. A new technique

will evolve—or are such films as " The Blue Angel " and " Sous les Toits de Paris " mere flashes on the screen, and not an indication that the new film is approaching adolescence ?

Mr. Rotha's survey of the cinema is exhaustive, but is so readable that it will appeal equally to the student and the general reader. So pictorially lavish is the book that it is worth possessing for its well chosen collection of " stills," which form a definite survey of the film. Apart from its other merits, it contains an appendix giving a list of production units with dates, names of producers, designs and casts of the outstanding films, which will be invaluable to the student of the " newest of the Arts."

Jewish Travellers. Edited, with an Introduction, by ELKAN NATHAN ADLER. (Routledge. 15*s*.).

This volume of the " Broadway Travellers " series comprises extracts from the records of travels made by members of the Jewish community between the ninth and the eighteenth centuries. The majority of them come within the Middle Ages, and three only are later than the sixteenth century. It is probable that, with the exception of the famous Benjamin of Tudela, even the names of these travellers will be unfamiliar to most readers. To make their acquaintance, therefore, will be the greater gain. It will perhaps be something of a surprise, and will give a new orientation to the view of the Jew's position in these times, to find that the first of the extracts, taken from the " Annales " of Eginhard, records the travels of Isaac, who was a member of an embassy from Charlemagne to the court of Haroun al Raschid.

The travels cover a wide range of country in the eastern world of their day, and like those of contemporary Christian writers, give interesting views of conditions in the countries through which they passed. Their main interest, however, lies rather in the fact that they introduce the reader to an entirely new world which, to Christians, was almost a closed book—the world of Jewry Among eastern peoples at least, it lived a life of dignity and influence with, as always, widespread international relations. For this reason, though not for this reason only, the book is a welcome addition to a notable series.

Borough of Buxton Museum Guide. With a Foreword by SIR ARTHUR KEITH. (Buxton Museum. 6*d*.).

In view of the movement for the establishment of national museums, interest attaches to the publication of the first official guide to Buxton Museum, where an effort is being made to develop a collection of local interest. The museum was opened by Sir William Boyd Dawkins in September, 1928, and on his death in the following year, Sir William's valuable reference library of archaeological, geological, and anthropological works was presented. " In the library and museum," writes Sir Arthur Keith in a foreword, " visitors will find a key which opens a doorway into the distant past and gives a new and added interest to the dales and caves of Derbyshire."

Among the exhibits are mammalian remains from the Pliocene Ossiferous cavern at Dove Holes. Here, in the spring of 1902, discovereis were made which were considered to be among the most notable in the Kingdom. The remains consisted of bones and teeth of extinct animals in such variety and so complete that England was at once put on a level with France in this respect. These included the bones of the mastodon and the sabre-toothed tiger. In the course of working the quarry, a cave was discovered, and among the mass of clay and pebbles were mammalian bones and teeth, some water-worn and others with sharp fractures. The contents had clearly been introduced into the cave by water, flowing under geographical conditions which no longer exist. All the species discovered have been found in the upper Pliocene deposits of France and Italy, and undoubtedly belong to that age. Some of the bones present the characteristic teeth marks of the hyaenas ; and the preponderance of the remains of the young over the adult mastodons points to the selection by the hyaenas, who could easily master the calves, while they did not as a rule attack the large and formidable adults.

Sir William Boyd Dawkins had observed a similar selection in the case of mammoths in hyaena dens, into which the remains had been brought by those cave-hunting animals. He therefore concluded that the animal remains had been washed out of a hyaena den which then existed at a higher level, carried down into the rock and finally into the cave in which they were found. On the occasion of the official opening of the museum, Sir William referred to the collection as " the very oldest collection of animal remains from caves which had been met with in the whole world."

Many other interesting exhibits are described in a series of short articles by experts.

Correspondence.

" WHEN WHEELS REVOLVE THE WRONG WAY."

To the Editor of DISCOVERY.

SIR,

In an article on this subject which appeared in *Discovery* for November, it was stated that " for continuous illumination, the disc must revolve at such a speed as to place a hole behind the prongs every time they open. The least speed at which this will occur is when the product of the number of holes and revolutions per second equals the frequency of the tuning fork." Thus, if there are p holes in the disc and the disc rotates m times per second, the frequency of the tuning fork n is given by $n=m.p.$ For " continuous illumination " is it necessary that a hole should be behind the prongs every time they open ? Will it not be sufficient if one hole is presented behind the prongs for every two or more complete vibrations of the tuning fork ? For instance, if the prongs open x times, while one hole replaces the next hole, it follows that $n=x.m.p.$ Or again, if the prongs open a times, while one hole moves through b times the distance between two adjacent holes (a and b being integers), then $b.n.=a.m.p.$ The full significance of these will be evident if it is remembered that persistence of vision is the cause of " continuous illumination."

Yours faithfully,

Victoria College, S. CHIDAMBARAPILLAI.
Chulipuram, Ceylon.

The author of our article, Mr. V. H. L. Searle, writes :— " In actual practice no confusion results because, although theoretically there are many speeds of rotation which will give the impression of a stationary field of view, these will be of different intensity and the speed for maximum intensity is easily recognizable. It is also the case that more complicated geometrical viewing diagrams are used in order to avoid the possibility of mistake."

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